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OF THE

AMERICAN ROENTGEN RAY SOCIETY

SIXTH ANNUAL MEETING
JOHN HOPKINS HOSPITAL
BALTIMORE, MARYLAND
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Constitution

Article I.

Name.

This Society shall be known as the American Roentgen Ray Society.

Article II.

Object.

The object of the Society shall be the study and practical application of the Roentgen Rays.

Article III.

Section 1. Its members shall be active, corresponding, honorary and associate, and shall be persons interested in the object of the Society, recommended by at least two members, in writing, and approved by the Executive Committee, who must have proof of their good ethical standing with the medical profession. They shall be elected by ballot.

Section 2. Active members shall be residents of America, shall sign the Constitution and pay annual dues of five dollars ($5.00).

Section 3. No member who is in arrears for annual dues shall vote or hold office. Any member in arrears for more than two years, and duly notified by the Treasurer by registered letter, shall forfeit membership.

Section 4. Corresponding members shall be residents of foreign countries.

Section 5. Honorary members shall be persons who have distinguished themselves in Roentgen Ray research or practical work.

Section 6. Associate members shall be persons who are interested in the advancement of the Roentgen Ray but who are not actively engaged in radiographic or radiotherapeutic work whose membership is not otherwise provided for.

Section 7. Corresponding, honorary and associate members shall have all the privileges of active members except voting and holding office.

Article IV.

Officers.

The officers shall be a President, five Vice-Presidents, a Secretary, a Treasurer, an Executive Committee of three, and a Board of Censors, to consist of the last three ex-Presidents. The officers shall be elected annually by ballot.

Article V.

Duties of Officers.

Section 1. The President shall perform all the duties pertaining to that office, and shall deliver an address during the annual meeting.

Section 2. In the absence of the President, one of the Vice-Presidents shall preside.

Section 3. The Secretary shall keep, or cause to be kept, a correct record of all transactions of the Society in a permanent form. He shall send due notice of all meetings to each member, shall notify all members of committees of their appointment and of the duties assigned to them. He shall conduct the correspondence and perform all duties usually pertaining to his office.

Section 4. The Treasurer shall receive and be accountable for all money that shall come into his hands by virtue of his office. He shall give good and sufficient bond to the Executive Committee for the safe keeping and disposal of his trust, and shall make a full report to the Society annually. He shall pay out money only by the written approval of the President and Chairman of the Executive Committee.

Section 5. An Executive Committee of three members shall be elected as follows: One for three years, one for two years, and one for one year; thereafter one annually to serve three years. They shall hold the bond of the Treasurer, audit his accounts annually, arrange for annual meetings, and have general supervision of the affairs of the Society not otherwise provided for.

Section 6. A Board of Censors, consisting of the three last ex-Presidents, the senior member of which shall be the chairman. They shall consider all matters pertaining to the conduct of members of the Society, and after due consideration and investigation of complaints, if there appears to be misconduct, they shall communicate with the member in question. Upon a continuation of the misconduct, they shall refer the matter to the Society at its next meeting for further action.

Article VI.

Meetings.

The annual meeting shall be held on the Wednesday following the second Tuesday of December of each year, unless otherwise arranged by the Executive Committee.

Article VII.

A Committee on Publication consisting of five members, of which the President and Secretary shall be members, shall be appointed annually, by the President.

Article VIII.

This Constitution may be amended by a three-fourths vote of all the members present at an annual meeting, provided the proposed amendment has been read before the Society at least one day previously, and the hour for action has been set by the Society and announced in the open meetings for at least one day previously.

By-Laws

1. A Nominating Committee of three shall be appointed by the President on the first day of meeting. Said Committee shall make report on the second day of meeting.

2. The newly elected officers shall take office at the close of the last day of the meeting at which they are elected.

3. All matters of parliamentary usage, not already provided for shall be decided according to Robert's Rules of Order.

4. Essays designed for the program must be submitted, in whole or in part as requested by the committee, to the Executive Committee at least two months before the time of meeting of the Society.

5. Papers shall be limited in reading to twenty minutes. Openers of discussion shall be allowed ten minutes and all others five minutes. No person shall speak twice on the same subject, except by permission of the meeting.

6. A member found guilty of reprehensible conduct may be expelled from the Society on recommendation of the Executive Committee, and by a two-thirds vote of members present.

7. The order of business shall be:

(1.) Call to order.
(2.) Reading of minutes.
(3.) Unfinished business.
(4.) Report of committees.
(5.) Election of members.
(6.) New business.
(7.) Announcement of Nominating Committee by the President, or report of same to the Society.
(8.) Reading of essays.

Minutes of the Proceedings of the Sixth Annual Meeting

FIRST DAY—MORNING SESSION.

The Society convened and was called to order by the President, Dr. Leonard, in the clinical amphitheatre of the Johns Hopkins Hospital, at 9:45 A. M., with 71 members present.

The reading of the minutes of the fifth annual meeting being called for, the Secretary, Dr. Boggs, offered the minutes as printed in the volume of transactions for 1904, which on motion of Dr. Hickey were adopted as published.

The local committee of arrangements reported through its chairman, Dr. Frederick H. Baetjer. The report was received.

Dr. Geo. E. Pfahler, Philadelphia, moved that the exhibitors be requested to close the exhibit room during the sessions of the society. Carried.

Dr. Pfahler also moved that the exhibitors be requested to shield their tubes during the exhibitions of excited tubes. Carried.

The Secretary then read the following applications for membership, which had been approved by the Executive Committee: Bartlett, Ezra Albert, M.D., 20 S. Hawk St., Albany, N. Y.; Baetjer, Frederick H., M.D., 714 Park Ave., Baltimore, Md.; Bayliss, Alfred W., M.D., 592 Spring St., Buffalo, N. Y.; Biddle, Jas. G., 1112 Chestnut St., Philadelphia; Blanchard, Geo. W., M.D., Highland Falls, N. Y.; Boyd, Geo. J., M.D., 1500 7th Ave., Beaver Falls, Pa.; Bryant, F. Ottis, M.D., S. E. cor. Broad and Potter Sts., Chester, Pa.; Cassidy, Henry F., M.D., 408 Roland Ave., Baltimore, Md.; Crain, Wm. J., M.D., Montreal, Canada; Beetjer, Christian, M.D., 21 W. Franklin St., Baltimore, Md.; Franklin, Milton, M.D., 122 W. 47th St., New York, N. Y.; Goff, W. P., M.D., Clarksburg, W. Va.; Hazen, Chas. Morse, M.D., Bon Air, Va.; Hunter, Jas W., Jr., M.D., 216 Freemason St., Norfolk, Va.; Lange, Sidney, M.D., Cin-

cinnati, O.; Long, John Wesley, M.D., Greensboro, N. C.; Lyle, Wm. Clifton, M.D., 921 Green St., Augusta, Ga.; McDonald, Willis G., M.D., 27 Eagle St., Albany, N. Y.; Pennall, Howard Yarnell, M.D., East Downington, Pa.; Price, John C., M.D., 218 Connell Bldg., Scranton, Pa.; Stover, Geo. H., M.D., 1443 Glenarm St., Denver, Colo.; Strong, Frederick F., M.D., 176 Huntington Ave., Boston, Mass.; Van Allen, Harvey W., M.D., 19 Maple St., Springfield, Mass.; Vail, Frank P., M.D., 1616 I St., N. W., Washington, D. C.; Wallace, Wm. G., M.D., Ingram, Pa.

On motion of Dr. C. E. Skinner, New Haven, the Secretary was instructed to cast the unanimous ballot of the society for election to membership of these applicants, which he did.

The Secretary's report being called for, Dr. Boggs submitted the report as printed on page 24.

The Treasurer's report being called for, Dr. L. E. Custer submitted the report as printed on page 25.

The first paper was read by Dr. Henry Hulst, Grand Rapids, Mich., entitled "A Study of the Stomach and Intestines."

The discussion on this paper was opened by Dr. Chas. L. Leonard, Philadelphia, and was continued by Drs. Geo. E. Pfahler, Philadelphia; G. P. Girdwood, Montreal, Can.; K. Dunham, Cincinnati, and G. G. Burdick, Chicago, and closed by Dr. Hulst.

Dr. P. M. Hickey, Detroit, Mich., followed with a paper on "Skeletal Development." This paper was discussed by Drs. Geo. E. Pfahler, Philadelphia; G. G. Burdick, Chicago; J. Rudis-Jicinsky, Cedar Rapids, Ia.; M. I. Wilbert, Philadelphia; G. P. Girdwood, Montreal; H. Pancoast, Philadelphia; K. Dunham, Cincinnati; G. H. Stober, Denver, Colo.; M. Kassabian, Philadelphia; Brown, Boston, and, in closing, by the author.

Dr. Geo. E. Pfahler, Philadelphia, contributed a paper entitled "The Interpretation of Lung Negatives," which was discussed by Drs. P. M. Hickey, Detroit; Henry Hulst, Grand Rapids, Mich.; J. Rudis-Jicinsky, Cedar Rapids, Ia.; M. K. Kassabian, Philadelphia, and in closing by Dr. Pfahler.

On motion, the Society adjourned until 2 P. M.

FIRST DAY—AFTERNOON SESSION.

The Society reassembled and was called to order by the President, Dr. Leonard, at 2 P. M.

Dr. Frederick H. Baetjer, Baltimore, read a paper on "The Diagnosis of Aneurysms." This paper was discussed by Drs. P. M. Hickey, Detroit; Geo. C. Johnston, Pittsburgh; W. S. Newcomet, and Geo. E. Pfahler, Philadelphia; Henry Hulst, Grand Rapids, Mich.; J. Rudis-Jicinsky, Cedar Rapids, Ia., and, in closing, by the author.

The next paper was the President's Address. Dr. Leonard chose for his subject, "The Past, Present and Future of the Roentgen Rays."

Dr. E. G. Williams, Richmond, Va., followed with a paper entitled, "The Regulation and Measurement of the Therapeutic Dose of the Roentgen Rays." This paper was discussed by Drs. Russell H. Boggs, K. Dunham, M. K. Kassabian, G. C. Johnston, G. P. Girdwood and C. L. Leonard.

Dr. O. Shepard Barnum, Los Angeles, Cal., read a paper on "The Technic of the Roentgen Treatment of Keloids." The discussion on this paper was opened by Dr. H. Pancoast and continued by Drs. Boggs, E. G. Williams, Geo. E. Pfahler, G. P. Girdwood, P. M. Hickey and was closed by Dr. Barnum.

At this juncture the Chair appointed the following Nominating Committee: Dr. Geo. E. Pfahler, Philadelphia; Dr. A. Holding, Albany, and Dr. E. G. Meter, Reading, Pa.

The Society then adjourned until 9:30 A. M. Friday.

SECOND DAY—MORNING SESSION.

The Society reconvened and was called to order by the President, Dr. Leonard, at 9:30.

Dr. P. M. Hickey, Detroit, offered the following amendments to the constitution:

Article III, Section 1 to be amended by the insertion of "and associate" and "with the medical profession," the amended section to read as follows: "Article III, Section 1. Its members shall be active, corresponding, honorary and associate and shall be persons interested in the object of the Society, recom-

mended by at least two members, in writing, and approved by the Executive Committee, who must have proof of their good ethical standing with the medical profession. They shall be elected by ballot."

Further, that Article III, Section 6 be amended as follows: "Associate members shall be persons who are interested in the advancement of the Roentgen ray, but who are not actively engaged in radiographic or radiotherapeutic work whose membership is not otherwise provided for."

Further, Article III, Section 7, to read as follows: "Corresponding, honorary and associate members shall have all the privileges of active members, except to vote and hold office."

Further, that Article V, Section 3, Second Paragraph. "The Secretary shall have printed an alphabetically arranged list of the members of the Society, with their addresses, for free distribution to members applying for same. This list shall be revised from time to time and shall specify charter members" be eliminated from the constitution.

According to the constitution, these amendments laid over for action until the following day.

The Secretary read communications of regret at inability to attend the meeting from Drs. S. M. McCollin and Weston A. Price.

Dr. Gordon G. Burdick, Chicago, presented a paper on "The Present Status of Radiotherapy." The discussion was opened by Dr. A. Holding and continued by Drs. H. E. Waite, P. S. Montcur, Price, Brenneman, K. Dunham, C. E. Skinner, H. H. Cook, and closed by the essayist.

Dr. Geo. C. Johnston, Pittsburgh, contributed a paper on the "Preparatory and Post-operative Treatment of Carcinoma," which was discussed by Drs. J. Rudis-Jicinsky, H. Pancoast, and G. E. Pfahler. Dr. Johnston closed the discussion.

Dr. Wm. B. Coley, New York, followed with a paper entitled, "Late Results in the Treatment of Sarcoma." This paper was discussed by Drs. G. G. Burdick, Bowen, K. Dunham, J. Rudis-Jicinsky, Stevens, A. L. Gray, M. K. Kassabian, Geo. E. Pfahler, V. J. Willey, Geo. C. Johnston, the discussion being closed by Dr. Coley.

Adjourned until 2 P. M.

SECOND DAY—AFTERNOON SESSION.

The Society reassembled at 2 P. M., and was called to order by the President, Dr. Leonard.

The Nominating Committee reported as follows: President, Dr. Henry Hulst, Grand Rapids, Mich.; Vice-Presidents, Dr. Russell H. Boggs, Pittsburgh; C. E. Skinner, New Haven, Conn.; E. G. Williams, Richmond, Va.; Dr. E. W. Caldwell, New York; Secretary, Dr. Geo. C. Johnston, Pittsburgh; Treasurer, Dr. L. E. Custer, Dayton, O.; Members of Executive Committee, Drs. P. M. Hickey, Detroit, and Jos. F. Smith, Chicago.

On motion the Secretary was instructed to cast the unanimous ballot of the Society for the election of these nominees.

Dr. Geo. H. Stover, Denver, read a paper on, "The Rœntgen Treatment of Carcinoma," which was discussed by Drs. Price, C. F. Stokes, Geo. E. Pfahler, the discussion being closed by the essayist.

Dr. C. F. Stokes, U. S. N., followed with a paper entitled, "The Rœntgen Ray in Military Surgery."

On motion, a vote of thanks was extended to Dr. Stokes for his excellent paper.

Dr. Jos. F. Smith, Chicago, read a paper on "The Treatment of Lymphatic Leukemia," and Dr. Henry Pancoast, Philadelphia, contributed a paper on "The Rœntgen Treatment of Hodgkin's Disease, Leukemia and Polycythemia." These two papers were discussed by Drs. A. L. Gray, Geo. E. Pfahler, W. S. Newcomet and Henry Hulst. The essayists closed the discussion.

Dr. J. Rudis-Jincinsky, Cedar Rapids, Ia., contributed a paper entitled "The Pathological and Physiological Effects of the Rœntgen Rays."

Dr. R. H. Boggs moved that Dr. S. M. McCollin's paper be read by title and published in the transactions of the Society. Carried.

On motion, Dr. Boggs was requested to speak on the "Technic of Calculus Diagnosis."

The Society adjourned until 9 A. M. Saturday.

THIRD DAY—MORNING SESSION.

The Society reassembled at 9 A. M. and was called to order by the President, Dr. Leonard.

The amendments to the constitution proposed by the Executive Committee, through Dr. Hickey, the day previous, were read again, and, on motion of Dr. Pfahler, they were adopted unanimously.

The motion made by Dr. Pfahler that the society adopt the terminology adopted by the Rœntgen Congress at Berlin, was lost.

The motion of Dr. Dunham that a committee be appointed to consider this matter and report at the next meeting was declared out of order by the Chair.

Dr. Gray moved that the whole matter be laid on the table. Carried.

Dr. R. H. Boggs opened the discussion on the subject of "The Technic of Calculus Diagnosis," which was participated in by Drs. A. L. Gray, H. Pancoast, J. F. Smith, Henry Hulst, M. K. Kassabian, C. L. Leonard, G. E. Pfahler, Price, G. C. Johnston, S. Tousey and L. E. Custer.

Dr. G. P. Girdwood, Montreal, read a paper entitled "The Treatment of Lupus and Rodent Ulcers," which was discussed by Drs. Tousey and C. L. Leonard.

Dr. W. S. Newcomet, Philadelphia, contributed a paper entitled "The Treatment of Non-Malignant and Non-Tubercular Skin Lesions."

Dr. Geo. E. Pfahler demonstrated a Rœntgen Ray filter and a universal diaphragm.

Dr. F. F. Strong, Boston, exhibited a unipolar X-ray tube.

Dr. Geo. C. Johnston exhibited a new mercury interrupter, and Dr. G. G. Burdick exhibited a developing machine run by water power.

Lantern slides were shown by Drs. G. H. Stover, P. M. Hickey, G. P. Girdwood and C. L. Leonard.

At this juncture the President-elect, Dr. Henry Hulst, was introduced to the society and escorted to the chair. He addressed the Society briefly.

On motion, the Society tendered a vote of thanks to the trustees of the Johns Hopkins Hospital for the courtesies shown the Society, and also to Dr. Baetjer for his very efficient services in the capacity of chairman of the Local Arrangements Committee.

There being no further business to come before the Society, an adjournment was taken, *sine die*, subject to call by the Executive Committee.

CHARLES LESTER LEONARD, *President.*
RUSSELL H. BOGGS, *Secretary.*

Annual Report of the Secretary of the American Roentgen Ray Society

The correspondence of the past year has shown the increasing interest by the physicians all over the United States, and an attempt has been made by the Secretary to answer all these letters as fully as possible.

The publication of the Transactions and a greater part of correspondence in regard to the program has devolved upon the President, as the Transactions could be published at a much less expense in Philadelphia, since many of the original articles were published in the American Medicine, and on account of the President being located near the place of meeting.

The Transactions consisted of 1,000 volumes, all of which were bound. The total cost of publication and distribution was $599.87, less $125.00 credit, paid by advertisers. The net cost per volume delivered, including 11 cents postage, was less than fifty cents. The copies were distributed to each member; to 35 libraries; to the officers of foreign Rœntgen Societies and members of the following learned Societies: The American Surgical Society; The American Gynaecological Society; The Association of American Physicians and the American Genito-Urinary Association.

The delay in sending out the preliminary program was caused by the refusal of the Belvedere Hotel to give the space or electricity which they had previously agreed upon for exhibition purposes when the time came for final arrangements to be completed, and the necessary delay consumed in correspondence with the Executive Committee. Both the President and Chairman of the Local Committee should have a vote of thanks for their hard work in securing the favorable headquarters and exhibition facilities at the Stafford Hotel.

After a great deal of correspondence, dating from April 1st, arrangements have been made with the various passenger associations, with the exception of the New England States, for a fare and a third rate on a certificate plan. Members are therefore requested to register their names and addresses in a book provided for that purpose and should leave their tickets at the Secretary's desk. A special agent will be present on September 29th and all tickets must be turned in before this time in order to secure reduced rates.

Annual Report of Treasurer

Report of Treasurer, L. E. Custer, D.D.S., from October 26, 1904, to September 27, 1905.

RECEIVED

From Ex-Treas. W. A. Price	$317 62	
Dues (and exchange, 15c.)	415 15	
C. F. Birtman Co.	1 20	
G. Cramer Dry Plate Co.	35 00	
N. Y. Med. Book Co.	1 00	
Waite & Bartlett	70 00	
Blakiston & Co.	1 10	
	$841 07	

EXPENDED

For Postage		$ 13 56
Express		2 00
Guysbert B. Vroom		29 06
Fred C. Zapffee		115 00
Brelsford Printing Co.		3 25
John Bornman Sons		2 00
H. C. Bennett, dues returned		5 00
Day-book		10
F. C. Nunnemacher		21 63
C. L. Leonard		23 00
W. J. Dornman		14 00
A. H. Sickler & Co.		599 67
		$828 27
Balance in Treasury		12 80
	$841 07	$841 07

Program

1. "A Study of the Stomach and Intestines," by Dr. Henry Hulst, of Grand Rapids, Mich.

2. "Skeletal Development," by Dr. P. M. Hickey, of Detroit, Mich.

3. "The Interpretation of Lung Negatives," by Dr. G. E. Pfahler, of Philadelphia.

4. "The Diagnosis of Aneurysms," by Dr. Frederick H. Baetjer, of Baltimore, Md.

5. The President's Address: "The Past, Present and Future of the Rœntgen Rays," by Dr. Charles Lester Leonard, of Philadelphia.

6. "The Regulation and Measurement of the Therapeutic Dose of Rœntgen Rays," by Dr. E. G. Williams, of Richmond, Va.

7. "The Treatment of Epithelioma," by Dr. S. Mason McCollin, of Philadelphia.

8. "The Technic of the Rœntgen Treatment of Keloids," by Dr. O. Shepard Barnum, of Los Angeles, Cal.

9. "The Present Status of Radiotherapy," by Dr. G. G. Burdick, of Chicago, Ill.

10. "Preparatory and Post-operative Treatment of Carcinoma," by Dr. Geo. C. Johnston, of Pittsburgh, Pa.

11. "Late Results in the Treatment of Sarcoma," by Dr. W. B. Coley, of New York.

12. "The Rœntgen Ray Treatment of Carcinoma," by Dr. G. H. Stover, of Denver, Col.

13. "Some Physical Properties of the Rœntgen Rays," by Prof. Robert W. Woods, of Johns Hopkins University.

14. "The Technic of Calculus Diagnosis," by Mr. Archibald D. Reid, F.R.C.S., of Kings College Hospital, London, Eng. Discussion opened by Dr. Russell H. Boggs, of Pittsburgh.

15. "The Treatment of Leukæmia," by Dr. Joseph F. Smith, of Chicago, Ill.

16. "The Rœntgen Treatment of Hodgkins Disease, Leukæmia and Polycythæmia," by Dr. H. K. Pancoast, of Philadelphia.

17. "The Treatment of Lupus and Rodent Ulcers," by Dr. G. P. Girdwood, of Montreal, Canada.

18. "The Treatment of Non-malignant and Non-tubercular Skin Lesions," by Dr. W. S. Newcomet, of Philadelphia.

19. "The Rœntgen Ray in Military Surgery," by Surg. C. F. Stokes, U. S. N.

20. "The Pathological and Physiological Effects of the Rœntgen Rays," by Dr. J. Rudis-Jicinsky, of Cedar Rapids, Iowa.

President's Address

The Past, Present and Future of the Roentgen Ray

BY CHARLES LESTER LEONARD, A.M., M.D.,
Philadelphia, Pa.

A review of what has been accomplished in the decade since Rœntgen's discovery is a fitting subject for the annual address in this decennial year. Congratulation on what has been accomplished, and a stimulus for future work can be gathered from it, while it will form a base from which we can attempt to look into the future.

This discovery was so fundamental that it has led to revolutions in thought and theory. It has led to other discoveries that are perhaps more revolutionary, but the parent discovery of invisible radiant energy capable of penetrating opaque substances was due to Rœntgen.

The subsequent discoveries by Bequerel and the Curies of radiant energy as a property of inorganic matter, was a natural consequence. Its bearing was, however, greater for it altered the concept of matter and disrupted the atom and the molecule, giving a fresh impetus to scientific thought and research.

Before taking up its application in medicine and the progress that has been made, I will be even more retrospective and quote from the writings of a classical author in literature, words that were written in 1871, which seem almost prophetic. These quotations refer to a subtle fluid or radiation that was emitted from a rod carried in the hands of wise men. He wrote:

"This fluid is capable of being raised and disciplined into the mightiest agency over all forms of matter, animate or inanimate. It can destroy like the flash of lightning; yet differently applied it can replenish or invigorate life, heal and preserve, and on it

they chiefly rely for the cure of disease, or rather for enabling the physical organization to re-establish the due equilibrium of its natural powers, and thereby to cure itself. * * * From it they extract the light which supplies their lamps, finding it steadier, softer and healthier than the other inflammable materials they had formerly used."

"But the effects of the alleged discovery of the means to direct the more terrible force of this agent were chiefly remarkable in their influence upon social polity. As these effects become familiarly known and skilfully administered, war ceased, for they brought the art of destruction to such perfection as to annul all superiority in number, discipline or military skill."

Further, in speaking of the uses made of this agent therapeutically, he says:

"It is their custom, also, at stated but rare periods, perhaps four times a year, to use a bath charged with this substance. I once tried the effect of the bath. It was similar in its invigorating powers to that of the baths at Gastein, the virtues of which are ascribed by many physicians to electricity; but although similar, the effect of this bath was more lasting. They consider that this fluid, sparingly used, is a great sustainer of life; but used in excess, when in the normal state of health, rather tends to reaction and exhausted vitality."

"For nearly all their diseases, however, they resort to it as the chief assistant to nature in throwing off the complaint."

We may shortly expect to find the radium bath employed, in addition to radium and fluorescent waters internally administered, and probably with as good a mental effect.

The description of the wand employed in the use of this agent suggested, though crudely, the radium pencil, while it was wisely tempered in its power according to the wisdom of those entrusted with it, and the uses to be made of it, for he says:

"It is hollow, and has in the handle several stops, keys or springs by which its force can be altered, modified or directed—so that by one process it destroys, by another it heals; by one it can rend the rock, by another disperse the vapor; by one it affects bodies, by another it can exercise a certain influence over minds."

"It is usually carried in the convenient size of a walking staff, but it has slides by which it can be lengthened or shortened at will. * * * Its powers were not equal in all, but proportioned to the amount of certain properties in the wearer in affinity, or *rapport* with the purposes to be effected. Some were more potent to destroy, others to heal, etc.; much also depended on the calm and steadiness of the manipulator."

Thus what we term the personal equation was given its true value in estimating the result that would be produced.

But he comes closer to the new property of matter recently discovered in this paragraph:

"But when you talk of matter as something in itself inert and motionless, your parents and tutors surely cannot have left you as ignorant as not to know that no form of matter is motionless and inert; every particle is constantly in motion and constantly acted upon by agencies of which heat is the most apparent and rapid, but this agent is the most subtle, and, when skilfully wielded, the most powerful. So that, in fact, the current launched by my hands, and guided by my will does but render quicker and more potent the action which is eternally at work upon every particle of matter, however inert and stubborn it may seem. If a heap of metal be not capable of originating a thought of its own, yet, through its internal susceptibility to movement, it obtains the power to receive the thought of the intellectual agent at work on it; and which, when conveyed with a sufficient force of this power it is as much compelled to obey as if it were displaced by a visible bodily force. It is animated for the time being by the soul thus infused into it, so that one may almost say that it lives and reasons."

These quotations are from Lord Lytton's book, "The Coming Race," and sound almost prophetic when viewed with our present knowledge.

It is impossible to trace out in science the effect of the impetus given by Rœntgen's discovery, or even to more than refer to some of its achievements in advancing medical science. A brief review must suffice and then a few suggestions as to the paths future efforts must take as kindly expressed for your benefit by prominent workers in other lands. Finally a correlation of

facts lately discovered in various fields of science will form the excuse for giving you the speculative thoughts they have suggested.

At the time of Rœntgen's discovery the world of science was in a receptive state well fitted to grasp and utilize it. The rapid progress made in a decade testifies to the fertility of the soil. The developments in apparatus and technic show the ingenuity and skill of the physicist and manufacturer of instruments. Without their aid the marvels of diagnosis and therapy would have been impossible. The medical profession recognizes this debt and is glad to acknowledge it.

This marvelous progress is however also the result of hard study and the development of technic on the part of the operator. He has established the accuracy of this method of diagnosis and made the medical profession realize that the man is negligent of his duty to his patient who neglects to employ it. He has elicited from expert diagnosticians praise and commendation for its delicacy and exactness.

To the surgeon it has become an absolute necessity and in many fields of diagnosis the neglect of its employment either shows his ignorance of a valuable modern method or his wilful neglect of his patients' interests. The accuracy of skiagraphy in fracture diagnosis was at one time questioned with a desire to discredit its findings as evidence in court. Today the court will hold the consultant responsible who fails to employ it when it is possible, and progressive medicine will soon leave such surgeons far behind.

Besides this element of accuracy, it has helped to explain the pathology of many surgical conditions, especially in orthopaedic surgery, and increased the efficiency of treatment. The problems of calculous nephritis and ureteritis are an example, for besides increasing the accuracy of diagnosis, this method has cleared up the pathology and altered the indications for operation.

Another refinement in surgical diagnosis is seen in the location of cerebral tumors, where its aid is important when it is possible to obtain accuracy.

In medical diagnosis the thorax, on account of its sharp contrasts in densities, has afforded the most fertile field. Fluorosopic examinations have rendered valuable results, but the greater accuracy has followed the advent of instantaneous exposures. The employment of opaque solutions in the hollow viscera, is not a method of recent date, but the rapid exposure has increased their value and great progress may be expected in this direction.

The most surprising and possibly the most valuable property of the Rœntgen radiations has been the development of its therapeutic power. As mysterious as is its power to show the bones hidden within the flesh by invisible rays, is its power to stimulate nutrition and alter metabolism without actual contact with the patient. Although its exact physiologic action remains unknown, the results achieved prove its power. It eradicates diseased tissue not by mutilation and its removal from the body, but by an action upon the pathologic cells which restores them to normal conditions. No other agent in therapeutics can produce such restorations. Whether it acts directly upon the cell or influences it through its effect upon the circulation, there is a power exhibited which is capable of doing great good. The universal action exhibited in widely varying fields can be accounted for only by an action on the cells themselves, or their metabolism through the medium of nerve energy or nutrition supplied.

The field of its application is ever widening with ever improving results, which are standing the test of time, so that what were apparent cures can be demonstrated to have been absolute. The therapeutic potency of the Rœntgen Rays is established and acknowledged by minds open to conviction.

These results must be kept distinct from those obtained by other radiations until the others have shown themselves worthy to be classed with it in power and varied action by their individually produced results.

Radium must prove that its radiations have equal therapeutic power before the two can be associated in therapy.

So with other adjuvant methods of treatment. The fluorescence of salts under the Rœntgen Rays is an evidence of energy

absorbed in chemical action is it reasonable to suppose that energy dissipated in such a manner can increase therapeutic effects?

The problem of advancing Rœntgentherapy is to utilize its energy more fully, not to dissipate it. Improvement in technic and in our knowledge of the action of its various qualities and their applications will advance its usefulness, more than confusing its actions by associating its employment with agents whose action, if any, has not been demonstrated.

With the idea of possibly giving fresh impetus to investigation, or of suggesting a thought that will be later worked out, I asked some of our fellow workers abroad to write a few suggestive thoughts, as to the directions in which investigation might be carried or improvements be made. Of those asked, Dr. Leopold Freund, of Vienna, and Dr. Albers Schonberg, of Hamburg, responded with suggestions as to methods and directions in which work can be pushed forward.

Dr. Freund wrote:

"To give a distinct prognosis of the future of the Rœntgen Ray is a difficult matter as the results up to the present time are so far reaching and technic seems so perfect. I think that with the knowledge we already have further rapid progress in medicine can hardly be expected. Meanwhile new paths for research await the strenuous efforts and discovery of scientists in medicine and other fields. Such a result, for instance would be the production of a tube, which would reduce to a minimum the secondary or vagabond rays and would be capable of giving out uniform radiations of any given quality.

"There might be a method worked out by which through the incorporation of harmless substances, which are opaque to the X-rays, in the tissues, differential shadows could be produced between pathologic and normal structures. The perfecting of methods for measuring the intensity of the Rœntgen Rays would add materially to our knowledge and afford accurate guidance in the vexed question of the length of exposure. What can be accomplished under certain conditions is well known. The study of arterial diseases promises much. I do not mean the study of the main blood vessels and the heart, which can be accom-

plished without this development in technic by so many operators in all lands, but I mean that the peripheral blood vessels may be shown, not, perhaps by the *workman* in Radiology but by the *master*. Valuable data can be secured by Radiography concerning the condition of the larger intestines, the physiology of renal secretions, the emptying of the bladder and perhaps also concerning the sexual functions. Without being a prophet and without being really scientific one can glide from the foregoing into phantasies; however, I think that certain already accomplished work indicates the possibility of accomplishing that suggested.

"The future of Rœntgen ray therapy can be most clearly recognized by appreciating the character of its physiologic action. We remember that on the one hand, it alters the blood vessel walls in a characteristic manner, that on the other hand, it exerts a distinctly special influence upon the cell elements. When we realize in addition that these rays may possess therapeutic properties dependent upon unrecognized actions, that will later be appreciated as of therapeutic value, we will find that many diseases that now resist our technic and our knowledge of the qualities of the Rœntgen Rays will be beneficially influenced. I should like to call attention to the disease of the blood vessels, as an indication of the special value of the rays in the production of the valuable results in Addison's disease. When the truth of this theory shall be verified we shall be at the commencement of an epoch in which one method will produce an amelioration or a cure in numberless, as yet, hopeless conditions; when it shall be proven in addition that the action of the Rœntgen Rays is primarily due to the changing of the lecithins of the tissues into cholin and other altered products of lecithin, we shall have in our hands an agent capable of influencing beneficially pathologic processes which depend upon the overproduction of lecithin containing tissues, as for example many diseases of the brain. I have already undertaken certain researches in this direction.

"In addition, many diseases of the circulatory system may readily be benefited by the action of the Rœntgen Rays upon the blood vessels.

"When in addition we shall have gained complete control of our apparatus, shall know which quality of rays is appropriate to each disease, which best employed in the depths and on the surface of the body, when our methods of measurement are perfected, there will then be presented an ever-widening field for our endeavors, a field in which we have all worked with our best powers, which holds our interest, has filled our lives and in which we labor for the good of mankind and the glory of knowledge."

The suggestions of Dr. Albers Schonberg are of a somewhat different character; he says:

"I consider it essential to progress, that the practice of Rœntgenology be restricted to the medical profession, that eventually an examination will be required which will show the physician's qualification for carrying out Rœntgen technic. In therapy, in addition to diseases of the skin, anomalies of the uterus and ovaries together with menstrual disorders will be successfully treated. In obstetrics it will be applied to accurately diagnose twin pregnancies. In internal diagnosis the early recognition of tuberculosis of the lung will be accomplished by instantaneous exposures during the cessation of respiration.

"An improvement in technic will result from the employment of perfected water-cooled tubes and the thorough carrying out of partial and general protective measures.

"These suggestions are possibly in the minds of some or all, but in bringing them to your attention an impetus may be given to your thoughts that may result in other more important discoveries or the accomplishment of those suggested."

This brief review of the progress made in medical science as the result of the introduction into it of the radiations from a Rœntgen tube is very suggestive in its bearings on what we term metabolism, or the life process of the cell. As has been suggested in Freund's remarks, there is probably more than one or two physiologic actions brought to bear upon the vitality and chemical activity of the cell.

In the first place the vascular system is undoubtedly greatly influenced as marked changes are found in pathological examinations. These changes have, however, been chiefly noted in cases

of tissue injury. There undoubtedly must be varying degrees of this action starting with mild stimulation and ending with devitalization. Then again, there is the chemic change in the cell itself, the stimulation of its autolytic ferments, as some authors put it, resulting in the dissolution of the cell. Again recent pathologic researches tend to show that malignant cells owe their harmful character to an acquired inherent and unexplained increase in their energy of growth. Does the Rœntgen energy neutralize or counterbalance this increase in energy and thus bring about their destruction or return to the state of normal cells?

The Rœntgen radiations proceed from a tube at a distance from the cells they influence—is it possible that they carry into the tissue that which neutralizes the excessive energy, and that, as a result, chemical changes are set up which destroy the cell?

Although such speculative theorizing leads far from solid or demonstrable facts, let us look for a moment with a purely philosophic purpose into some of the recent discoveries of science, and see if by their correlation any shadow of ground can be found upon which to base so purely speculative an hypothesis.

The first five years of the new century have been marked by many discoveries of note. In biology the relation of cellular life to chemic activity has been demonstrated to be so intimate that a sexual reproduction has been produced by chemical agents. Certain cells have been shown to possess a form of polarity, the larvæ of caterpillars, for instance, turning uniformly one pole toward certain radiations, even when the position of its source is frequently changed. It has also been demonstrated that chemical changes termed metabolism are more or less intimately interdependent upon the positive or negative electrical charges associated with them. The result of the discovery of radiation in inanimate matter has influenced the theories of chemistry and we find the positive or negative ion brought into relation with the processes of chemical combination.

The discovery of radio-activity in what was supposed to be inanimate and solid matter has led to a far reaching study of radiation, not only in the radio-active salts, but in objects which do not possess this property inherently.

The experiments of Elster and Geitel show that substances can be made radio-active without the presence of any radio-active salt, through the medium of negative charges of electricity, or the radiations from a Crook's tube.

The experiment of Rutherford and Soddy with Thorium, its division into parts that were radio-active and non-radio-active; their separation by a great distance, and the final loss of radio-activity in the part that had had it, and the production of this property in the part that had it not, suggests a comparison of this process as observed in this inanimate salt with the life and death of animate objects. In the Thorium the property of radiation ceased or died in the part that had it, while it was produced or created in the portion which had it not.

Is this not suggestive of a possibility that life in animate things ceases when they cease to give up ions, charged with one form of what we term electricity, while life begins by the assumption of this function of producing ions?

Cathode rays are supposed to be made up of exceedingly small particles, called corpuscles, charged with negative electricity and form ions which travel many thousands of miles per second.

Radium emits negatively charged ions. This radioactivity, this discharge of positively or negatively charged ions, takes place from the leaves of trees, the plants, the animal and the vegetable life; the animal life discharging positive ions, while plant life gives off negative charges.

Can there be any relation between the discharge of oxygen from plants and the negative ions or radiations they give out? Likewise can the nitrogen given off by the animal body be connected with the discharge of positive ions? Is the necessary interchange between plant and animal life of nitrogen and oxygen not a mode of transferring positively and negatively charged ions?

Does oxygen, does animal life bear any relation to negatively charged ions and are they essential to the balance of polarity in cells? to the stimulation of chemical changes by an influx and interchange of electric ions? Is the combustion of tissue, the absorption of oxygen processes by which the polarity of cells are altered or balanced, and its metabolism and life dependent upon the potential equilibrium of cells?

Is life a process of electrical interchange which stimulates metabolic changes in plant and animal? Is it one and the same with the radio-activity of material cells, atoms and molecules whether animal, vegetable or mineral? Do the changes termed metabolism in cells really represent changes in electrical potential or polarity? And is radio-activity simply a form of atom metabolism discovered in inanimate matter?

If we conceive that there is any truth in these theories, then possibly they will yield a further explanation of the influence of Rœntgen radiations upon tissues and metabolic processes for the cathode rays are probably molecules of oxygen charged with negative electricity that bombard the anticathode and produce the X-rays, so the X-rays are ether pulsations charged with negative electricity or negatively charged ions, which are carried into the tissues to stimulate by adding their charges where they will stimulate, and destroying where over stimulation or the addition of an excess of negative electricity will change the polarity of the cell and bring about destructive changes or autolysis.

To make this theory applicable to the results seen in the treatment of malignant disease, we have only to assume that malignant cells owe their increased energy of growth, upon which their malignancy is now said to depend, to a condition of over charging with negative electricity, upon which the energy of all metabolic activity depends. For we know that the Rœntgen rays can discharge charged bodies and can therefore conduct electricity. It may therefore be able to alter this polarity or potential of those cells enough to assure their destruction.

It matters little if this speculation is idle or that it is purely speculative theorizing, if it be suggestive and lead to wiser thoughts and theories that end in studies that will demonstrate truths.

It has at least served one purpose and helped me to fulfill the duty which the honor you conferred upon me has made a pleasure.

Roentgenography in Diseases of Stomach and Intestines

BY HENRY HULST, A.M., M.D.
Grand Rapids, Michigan.

Owing to the researches of Ewald, Boas, Van Noorden, Einhorn, Hemmeter, the stomach and intestines are receiving more attention than ever before. As a result, not only the stomacho-enterologist, but the general practitioner as well, is impressed with the importance of the study of these organs.

Bouchard recognizes in dilatation of the stomach the cause of several forms of autointoxication.[1] The gynecologist, W. Gill Wylie attributes to enteroptosis much of the suffering of women generally referred to displacements of pelvic organs.[2] Reed agrees with Stockton when the latter states that more than fifty per cent. of all civilized women in all classes of life have developed the condition known as enteroptosis, and that "this condition more than any other cause is responsible for the constipation, backache, debility, biliousness, early loss of complexion, headache, and that long list of ailments of which so many women in all civilized countries are victims."[3] Reed found in a total number of 710 cases examined by him, 362 in whom the greater curvature of the stomach was at or below the umbilicus. Of these 362 two-thirds were females.[4] "We notice, then," remarks Bouchard, "in individuals who present the physical signs of dilation of the stomach: 1. Pulmonary phthisis. 2. Chlorosis (both of which accompany gastric dilatation, the first in two-thirds of the cases, the second in four-fifths). 3. Nervous or hypochondriac symptoms. We see men without energy who present themselves at the hospital because they can no longer work on account of physical and mental debility; we make an error in diagnosis. 4. Lastly, other symptoms, so varied and so numerous that their mention at first provokes incredulity."[5] Arneill inclines to sim-

ilar views.[6] According to Meynert the normal position of the stomach in the female sex is the exception.[7] In the male it is more difficult to recognize on account of the rigid abdomen.[8]

Now if there is any truth in all this, if Glenard's disease, as Splanchnoptosis has been called since 1885, is as common as authorities would have us believe, and causes but a moiety of the suffering now traced to it, though formerly ascribed to other causes—no one is more directly concerned with this affection than is the general practitioner. To him especially it becomes a matter of most vital importance to be able, under all circumstances, to recognize it and to determine accurately its degree of severity. But just this has been hitherto by no means an easy task, as is well illustrated by the very fact that, in spite of the work done on frozen and hardened cadavers by His, Sernoff, Mall, Birmingham, and in spite of the enormous mass of clinical data collected by specialists in their daily observation, the position of the stomach in the living subject remains a matter of controversy. The vertical stomach is still spoken of as abnormal by the followers of Luschka, though Doyen and his disciples insist that the normal, and not merely the embryonic, position of the stomach is vertical. And as to the colon, Billings sums up the matter thus: "The introduction of a rectal tube and blowing in air or water and noting the position of the end of the tube by auscultation and percussion, the distention of the colon by air or water, are the diagnostic methods recommended by Hemmeter."[9] Howard Kelly demonstrated transillumination of the colon in 1891.[10] What these methods have amounted to practically is well indicated by Reed as follows: "Hitherto most colonic displacements have not been recognized during life; but in the records of autopsies in the hospitals of the world large numbers of them have been collected."[11] Bouchard admits frankly that "percussion is difficult and delicate to practice; sometimes insufficient; and is rendered false in its results owing to tympanitis of the colon," and that, "succussion furnishes no certain sign; it may bring out the noise of fluid in a normal stomach, and yet it cannot reveal the extent of the dilatation."[12]

Indeed, in the hands of most, the older methods of inspection, palpation, auscultation, percussion, auscultatory percussion,

with and without inflation by the pump or carbonic acid gas, electrodiaphany, fluorescing electrodiaphany, the use of bougies, Tuerck's gyromele, not to mention other methods, frequently yield but indifferent results; and in certain cases, such as aneurism, ulcer and cancer, are decidedly unsafe as well.

Einhorn's recent attempt to radiograph the stomach by means of radium bromide introduced into the stomach and kept there one or two hours with a photographic plate placed dorsally or ventrally, though very interesting in itself, resulted in nothing very useful, as his illustrated article in the last number of the Archives of Physiological Therapy indicates.[12]

In view of the difficulty of determining accurately the shape, size and position of the stomach and intestines by the methods hitherto in vogue it may seem strange that the Roentgen Rays have not been requisitioned into service in this interesting field of clinical research. Sporadic efforts, it is true, have not been wanting. Hemmeter tried to Roentgenograph the stomach as early as 1896, but concluded that "so far the Roentgen Rays have offered no decided aid for the diagnosis of intestinal diseases."[14] In 1903 he wrote, "Recently I have used the following method: The dilated stomach is coated internally with bismuth subnitrate by means of the powder-blower; thereafter its outline can be distinctly recognized through the fluoroscope."[15] About the same time (1897) Williams of Boston made several observations by means of the bismuth method.

But the Roentgen Rays failed nevertheless to secure for themselves universal recognition by the profession as a valuable, and therefore indispensable means in the diagnosis of enteroptosis, gastrectasia and allied conditions. It is unfortunately true, as Koehler remarks, in speaking of the Roentgenography of bones, that "there are not only thousands of ordinary physicians, but hundreds of authorities as well, in their respective fields, who look upon Roentgenological examinations as a superfluous luxury, as 'photographische Spielerei.'"[16] If true in general, this applies with even greater force to Roentgenography of the soft contents of the chest and of the abdomen. But the beautiful work recently done on this subject by Prof. Rieder of Munich should be as epoch making as was his Roentgenography of the

Mrs. F.—Immediately after bismuth meal. Penny on navel. Horizontal position. Another picture taken in the erect position showed the greater curvature one hand breadth below the rim of the pelvis.

lungs, and should open up a new and fertile field of research for the Roentgenologist while offering a boon to every serious general practitioner and stomacho-enterologist.[17]

TECHNIC.

There is really very little that is new in this method, just as there was nothing new in Roentgen's method when he discovered the rays now called by his name.

The difference of density of the tissues of the thoracic organs, which makes it comparatively easy to Roentgenograph them, is just what is lacking in those of the abdomen, except for occasional accumulations of gas in the stomach and bowels. To create this necessary difference we may inflate these organs as is done for purposes of percussion after the manner of the older methods. But inflation is often painful, at times dangerous, and not always adequate. The ingestion of some substance opaque to the rays, free from arsenic and safe to be taken in large quantities, naturally occurs to every Roentgenologist. There is nothing new in this use of bismuth subnitrate. It and sheet lead are to the Rœntgenologist what cotton and gauze are to the surgeon. Williams gave an ounce of bismuth in emulsion as early as 1897.[18] Though cases of poisoning have been reported in which bismuth was used as a dressing for burns as recommended by Bardeleben and in which the bismuth was proved to be perfectly pure,[19] Rieder observed no ill effects from its use when given in large doses internally.[20] I myself have administered it in one ounce doses in 30 cases and have seen no ill effects.

Williams' work was mainly fluoroscopic. "The outline of the stomach," he remarks, "was better defined on the fluoroscopic screen because the stomach moves during respiration and therefore its outlines are blurred on the radiograph."[21] Peristalsis also causes blurring. What more natural, therefore, than to reduce the time of exposure to a few seconds only? Rieder had but to apply the skill acquired by him in Roentgenography of the lungs to that of the stomach and intestines and the thing was done. It seems all very simple now. The subject receives a pint or more of milk (the capacity of the normal stomach being about 3 pints)[22] or of bread and milk, or of potato soup, into which has been stirred one ounce or more of the bismuth salt.

Immediately after this bismuth meal two dorso-ventral exposures are made, one in the erect (standing or sitting) and one in the recumbent position. The reason for this will become apparent later on. "If the practitioner does not wish the bismuth to pass on into the intestines, the stomach may be freed from it by means of the stomach-tube," remarks Williams in this connection.[23] But this would not serve our purpose at all; for we want the bismuth to pass on and thus to enable us to learn still more. Having determined the size, shape and position of the stomach by the Rœntgenographs now obtained, we want to know something about its efficiency next. For just as a normal stomach gets rid of a Riegel-Leubschen Probemahlzeit in from five to seven hours,[24] experience shows that it empties itself of the bismuth meal in about the same length of time.[25] Supposing that the first Rœntgenographs were taken at noon, the next one should be made at about six o'clock, the subject having taken neither fluids nor solids since noon. In case bismuth is found remaining in the lower segment of the stomach at six o'clock, as is sure to occur in gastric insufficiency (whether from dilatation, atony or obstruction from any cause) other exposures may be made at such intervals as seem best to determine accurately the length of time the stomach reqires to empty itself. This gives the degree of insufficiency. We have now ascertained about the stomach all that we can by our method, but in its passage through the bowels the bismuth may teach us still more. By making an exposure before bed time or next morning (ten or twenty hours after the bismuth meal), or later still if the patient gives a history of constipation, (say thirty-six to forty-eight hours, from the time the bismuth meal was taken) we may succeed, indeed we are almost certain to succeed, in obtaining a good idea of the location of the colon, especially its two flexures and its transverse portion. "To give a dram of bismuth twice or thrice daily, some time before meals for two days preceding," as Reed suggests,[26] is in reality a work of supererrogation. It is based, moreover, upon the mistaken theory that the bismuth collects in the stomach. A single meal is amply sufficient to give a perfectly clear picture of this viscus, and six hours later a Roentgenograph of a normal stomach will show no bismuth in it, but

the bismuth will have entered upon its final, long, thirty-foot journey.

If for any reason a serviceable picture of the colon is not secured by this stomach route of the bismuth method, it is still possible to secure one by the rectal method. Two or three ounces of bismuth in a quart of water is slowly introduced into the colon by means of a rectal tube. In my own experience this has never been necessary.

Some other points remain to be considered. It is not enough to obtain differentiation of tissues by means of the introduction of some opaque substance like bismuth subnitrate and then merely to press the button. The object to be Roentgenographed must be at rest. This rule applies inflexibly here as in all other cases. There must be no breathing, and as little peristalsis as is possible, to get the best results. If only the exposure is made sufficiently short after full inspiration or forced expiration, narcotics to allay peristalsis are unnecessary. In case of inadequate apparatus or great corpulency of the subject, one or even two tungstate of calcium intensifying screens may be needed. Although the contrast obtained by their use is inevitably at the expense of some detail they are not altogether objectionable in abdominal work of this kind, provided they are of superior quality. For although in Roentgenography of early phthisis intensifying screens are to be avoided because their use may defeat the very purpose of this work (the recognition of minute lung changes) the same objection can not obtain equally in Rœntgenography of the stomach and colon, in which we seek for detail less and for contrast more.

With a sixteen-inch coil, Wehnelt interruptor, but one intensifying screen, a strong tube yielding Walter six rays, placed twenty inches from the plate, I have succeeded easily in Roentgenographing the stomach of a medium sized subject in one second. I have a very good plate taken under the same conditions but without the use of intensifying screens in three seconds. Ordinarily, however, I prefer to balance Rœntogenographic factors in such a manner as to make the exposure for stomach and bowels at twenty inches in ten seconds without intensifying screens. A fact well pointed out by Caldwell, but not yet suffi-

ciently understood by all who attempt soft tissue work, is that the detail of soft tissues is best obtained by relatively high tubes and short exposures.[27] The reason, however, for shortening the exposure in this abdominal work is a very different one, the purpose being not to secure minute detail, as is the case in Roentgenography of the lungs, but to eliminate the bad effects of motion—motion of respiration and motion of peristalsis.

Even so the vagrant rays generated when using a Walter six tube are considerable, and quite sufficient to blur the picture. It has been pointed out frequently[28] that the function of the diaphragm is still not sufficiently appreciated; it requires, however, but little experience to become convinced of its imperative necessity in work of this kind.

The next point of technic to be considered is of vital importance. We must not lose sight of our purpose. This is, to obtain truthful information and not merely to make a pretty picture. By placing the tube too near the object we cause undue distortion; also by putting it too high or too low. For the sake of uniformity of results, which may serve as a basis of comparison, one must adhere to a fixed distance between plate and anticathode. I have adopted 20 inches. In all works on the stomach, the navel serves as an important landmark. Thus Butler says: "The lower border of a normal but much distended stomach may be found at the level of the navel. If below the umbilicus the condition is abnormal."[29] Unfortunately, its position is by no means identical in all cases. According to Quain, "It is generally a little (half an inch to an inch) above the highest point of the iliac crest, and about opposite the disc between the third and fourth lumbar vertebrae."[30] I therefore mark this point of the spine opposite to which the navel is found in normal bodies by means of a pen or dermographic pencil before posing the subject and centering the focus on the anticathode perpendicular to this mark. The actual position of the umbilicus may be indicated by means of a dime held on by sticking plaster.

According to Butler the cardiac orifice of the stomach lies four and one-half inches from the anterior surface of the body.[31] Robson and Moynihan place the pyloric end two inches in front of the cardiac end.[32] This would locate the pylorus two and one-

Mrs. M.—About twenty-one hours after bismuth meal. Wire around the body to bring out perspective when viewed stereoscopically. Case selected for Roentgenography to obtain normal data.

half inches from the surface of the abdomen. According to all the authorities I have been able to consult, the greater curvature approaches the surface of the abdomen according to the degree of its distention. Now if the lower border of a given stomach is one inch above or below the perpendicular between the focus of the tube and the third lumbar disc, and about two inches from the skin (depending of course on the amount of fat present), it will appear on the picture about one-eighth of an inch out of its true place, provided the focus is twenty inches from the plate. If, on the other hand, the lowest point of the greater curvature is two inches above or below the perpendicular it will appear about five-sixteenths of an inch higher or lower, as the case may be, than it is in reality. It may be difficult to get the focus exactly perpendicular to the third lumbar disc. A mistake of one inch, the greater curvature being two inches from the surface, will cause a distortion upwards or downwards of but a fraction of one inch. The distortion would be lessened by increasing the distance between focus and plate, but unfortunately this would increase the necessary length of exposure about according to the square of the distance. The present method, therefore, though not aiming at orthodiagrammatic exactitude, yields data of such accuracy and practical usefulness as to excel all other methods hitherto in use.

Contrast, immovability, all possible elimination of vagrant rays, truthfulness, having been thus provided for, there still remain one or two things to bear in mind.

My first stomach cases were Rœntgenographed in the dorso-ventral horizontal position. An interesting experience taught me the inadequacy of this method in an unexpected manner. Case No. 15 of the series reported in this month's number of the "Physician and Surgeon," published in Ann Arbor, was done in the manner mentioned above. This subject presented no gastric symptoms of any kind and was Roentgenographed for the purpose of obtaining data on normal stomachs. The lowest point of the greater curvature was found on a level with the third lumbar disc; that of the lesser, one vertebra higher. The next picture was taken an hour later, but this time with the patient in an erect position, and showed the lowest point of the greater curva-

ture one handbreadth below the umbilicus, while that of the lesser was found opposite the sacro-iliac synchondrosis.

This single instance may serve to show two important facts. First, that, though Boas says that the dorsal position is the most appropriate one for percussing,[33] Musser is right in insisting that the patient must always be examined in the erect as well as the recumbent position.[34] For the marked gastroptosis present in this case was not revealed in the first picture and would have escaped detection had not the patient been Roentgenographed in the sitting position as well. Second, this case serves to illustrate the significant fact that only a physical examination can determine the presence or absence of Glenard's disease; and that the mere absence of subjective symptoms counts for nothing in the negative diagnosis of this condition.

The normal stomach, on the contrary, does not descend markedly upon assuming the erect position. At any rate, the few normal stomachs I have been able to find remained very much the same in both conditions.

I shall have occasion to show you a case of gastroptosis taken first after full inspiration and next after complete expiration. You will agree with me that the difference caused by respiration, in this case, at least, is quite negligible.

Kuttner and Jacobson maintain that when transillumination (by electrodiaphany) shows distinct respiratory movement of the light zone the lesser curvature is in its normal position; and if the light zone is below the umbilicus these signs together indicate a dilatation, provided transillumination through the intestines can be excluded.[35]

To my surprise, the few normal stomachs that I have been able to find showed no more respiratory movement than the prolapsed ones. A Roentgenograph of a silver nitrate pill in the pyloric end of the stomach presented by me at the Philadelphia meeting of our society is of interest in this connection. The pill was opposite the third lumbar vertebra, and yet the movements of respiration during the one and one-half-minute exposure caused the round pill to appear only slightly oval. The Kuttner-Jacobson sign, therefore, is, to say the least, not infallible.

Further experience may induce us to view differently the

Miss N.—Four and three quarter hours after bismuth meal. Penny on navel. Pin in clothes. Scattered bismuth in coils of small intestines in pelvis. Gas in upper part of stomach. Part between the gas and bismuth mixture contracted to the size of a mere sinus.

effect of respiration upon the position of the greater and lesser curvatures of the stomach in health and in disease; but two things are therefore established now: The influence of the position of the body upon that of the stomach should not be ignored, and the degree of its prolapse cannot be accurately determined by an examination in the horizontal position alone.

And yet it may pay very well to take a picture in this manner for other reasons. When the subject lies upon the belly the stomach is brought nearer to the plate than when he sits or stands; when he lies down upon the plate the picture is clearer and more distinct. Also, in this manner, gravity causes the bismuth to settle upon the ventral surface of the stomach, thus permitting a better view of the fundus, cardiac end and general contour, than is always obtained by the examination in the erect position alone, in which latter case the bismuth sinks into its most dependent portion, and by its presence serves rather to reveal the lowest points of its two curvatures.

I found it desirable to construct a chair combining plate-holder, adjustable tube-holder and diaphragm, facilitating Roentgenography of feeble patients in the sitting position, so as to secure twenty inches between plate and focus. In order not to increase the paraphernalia only too likely to accumulate in a Roentgenological laboratory, I utilized the graduated tube-holders belonging to my compression-camera. For the standing position the same diaphragm, running in grooves and held by set-screws at any desired height, is reversed upon the chair, the plate-holder is clamped upon a cabinet designed for fluoroscopic examination of the heart and lungs but made to serve as well as a support for the patient to lean up against. A screen projection will show all this at a glance. For the recumbent position the framework of my compression-camera is closed down over the patient and the above described tube-carrying diaphragm is placed upon the frame acting as a support in such a way as to keep the focus 20 inches from the plate.

CONCLUSION.

The above described method was applied by me in the examination of thirty cases. Twenty-two of these are reported

in detail in this month's number of the "Physician and Surgeon," of Ann Arbor.

The present occasion does not permit entering into an analysis of them. Also, I shall resist the temptation of indulging in extensive generalization. My experience is quite limited and does not warrant me to make sweeping statements nor to herald novel and revolutionary ideas. Further observation by many other observers is needed in order to arrive at such conclusions without jumping at them.

I shall therefore content myself with demonstrating slides of some of the one hundred and fifty 14x17-inch negatives I have hitherto made, two or three of the negatives themselves to supplement the former, and, as somewhat of a curiosity, a reduced stereoscopic positive of a colon. Lastly permit me to summarize as follows:

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Diseases of the stomach and intestines, especially Glenard's disease, are receiving unusual attention and are of special interest to the general practitioner.

Their accurate diagnosis is attended with considerable difficulty, as is proven by the number of methods advanced.

The present method, though not as simple as some others, is both safe and accurate.

Its difficulties are not insuperable.

Good apparatus and a fair amount of skill suffice to ensure thoroughly satisfactory results.

Truthfulness is the chief criterion of merit in this work. Beautiful caricatures, the fruit of Roentgenological calisthenics, are out of place.

To be truthful and thus answer their purpose, Roentgenographs must be made correctly and interpreted according to the laws of projection. They should be the result of a uniform method to serve as a basis of comparison.

A Walter six tube ordinarily gives the best results. Children may be examined with a still softer tube.

The diaphragm is quite indispensable.

It is more than likely that this method will modify the current topography of the stomach and intestines on several important points.

Roentgenography of the stomach and intestines opens up a new and interesting as well as exceedingly wide field of research; it urgently invites us to put forth our very best efforts, and promises rich results.

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DISCUSSION.

DR. CHARLES LESTER LEONARD, Philadelphia: I wish to correct Dr. Hulst in one particular from the historical standpoint. I demonstrated a case of gastroptosis before the American Medical Association in Philadelphia in 1897, in which the lower curvature of the stomach was in the pelvis. Dr. Hulst makes short exposures; mine lasted three quarters of an hour. I discontinued the work because I did not think it worth while to spend so much time at it.

DR. GEO. E. PFAHLER, Philadelphia: This society is indebted to Dr. Hulst for presenting this very excellent paper and such beautiful skiagrams. After a few such demonstrations before general medical societies we ought to have little difficulty in convincing these gentlemen of the necessity of having this work done, although we may experience some little difficulty in convincing the general practitioner, the surgeon, the patient or the consultant that a reasonable fee must be charged to cover the expenses of the work involved in making these examinations. It requires five plates and five different abdominal examinations, each requiring about an equal length of time, to get such results as Dr. Hulst has shown us.

I have done a little work of this kind myself. Last May I presented a paper to the College of Physicians of Philadelphia, a society composed mostly of consultants, all of whom were very much interested in my paper. The case I presented was one of marked gastroptosis, the stomach moving downward very distinctly. One of the gentlemen stated that he had never seen a floating stomach, and quoted an authority who said that such a condition could not occur. If that physician could have been present today and seen Dr. Hulst's plates, I think he would be convinced that the condition does exist.

DR. GORDON G. BURDICK, Chicago: I was particularly interested in this paper because I had an experience with one of these cases several years ago. The case in question had a tumor, and it was somewhat difficult to determine whether this tumor had its origin in the stomach or elsewhere. I was asked to make

a radiograph. I gave the patient an emulsion of about an ounce of bismuth and got a very good plate showing that the tumor was not connected with the stomach. Strange to say, about thirty minutes after I gave the bismuth the tumor began to disappear very rapidly. The bismuth evidently was contaminated with arsenic, and it nearly killed the patient. It is almost unnecessary to say that the tumor was impacted faeces.

DR. KENNON DUNHAM, Cincinnati, O.: I would like Dr. Hulst to tell us what becomes of the bismuth between the stomach and the colon.

DR. HULST (closing the discussion): I did not know of Dr. Leonard's work, hence did not mention it. I think we owe it to Professor Rieder that we are now making use of this method. Dr. Pfahler's remarks are logical and true. It is unfortunate that they apply to all our work. Many physicians will not use the Rœntgen Ray for any purpose. When you do work of this kind they will tell you that it is better not to do it because it will blunt your diagnostic abilities. You must not use the thermometer; you ought to be able to feel your patient's temperature. You must not use the stethoscope, because if you do, you will blunt your hearing. And so it is with this matter, but, as a matter of fact, I have not experienced the difficulty that Dr. Pfahler described.

When I became interested in this work, I worked up eight cases and invited the local Academy to my house, where I gave them a demonstration. The surgeons were all interested; in fact, these cases were nearly all sent to me by surgeons. All you need to do is to show them that the work is worth doing, that the disease is so common that it must be diagnosed, and that this is the best way of doing it.

Your charge must be a fair one. My charge for this work is $75.00. Keep up your charges, but when you have a poor patient, do the work for nothing. When you do that, you will interest a sufficient number of people to keep busy at this work. I am going to work for a year with a surgeon to study the effect of surgical conditions on the topography of the abdominal organs.

One of my cases had been to one of the first clinicians of Europe for a diagnosis. He told her that her stomach was on the right side, and he also told her that he was one of three men in the world who could tell her where her stomach was. I made a radiograph and found that her stomach was on the left side. A single case like that will get the surgeons interested, and the general practitioner ought to be interested because fifty per cent. of his cases are suffering from the effects of that condition.

Dr. Dunham asks what becomes of the bismuth after it leaves the stomach on its way to the colon. That depends on whether there is a history of constipation. In some of the pictures you will see the bismuth beginning to collect in the coils of the small intestine. The jejunum is named correctly. It is empty. The food passing through the jejunum is liquified, and it passes through so quickly that you fail to get a picture unless there is a stenosis. Then it will not pass through the bowel at that point and that will serve to show where the stenosis is located. If the patient is naturally constipated, the condition is made worse, but not markedly. Be sure not to call for an ounce of bismuth without specifying a pure grade. Otherwise you will have the trouble mentioned by Dr. Burdick.

The Development of the Elbow

BY P. M. HICKEY, A.B., M.D.,
Of Detroit, Mich.

There is no fear of contradiction when we repeat that the elbow joint is the most troublesome to interpret in its radiologic representations. Its development from so many different centres whose bony changes take place at different ages, and the complexity of the joint when viewed from the structural and physiologic standpoint, combine to make the X-ray diagnosis of surgical traumatism often very difficult. It is the purpose of the author to present for your inspection a few slides of the elbow as met at different ages.

We will consider, first, the appearances present in lateral views, which ordinarily are the ones most commonly shown.

The distance between the ends of the bone is quite striking at the age of six years. The capitellum, appearing usually first in the second or third year, is plainly shown and of considerable size. It is apparently tilted forward, due to the more advanced development of the anterior portion. The dark ridge, indicating the greater density along the lower end of the shaft of the humerus, is quite prominent. The upper end of the ulna presents angles which are still quite obtuse. The head of the radius shows on careful inspection the little disk of its epiphysis, which may be present as early as the fourth year, or its appearance may be delayed until the seventh or eighth year.

The capitellum in another year increases in size and presents a more circular appearance. The growth has been more in a posterior direction, so that the joint space is much less conspicuous. The head of the ulna shows a more acute angle as the calcium salts are deposited further into the joint space. The radial epiphysis has increased in size. The structural framework of the lower end of the humerus is here excellently displayed, with the more compact tissue of the internal and external ridges in well marked distinction.

At nine years we see the epiphysis of the olecranon showing in triangular fashion, with its apex pointing toward the head of the humerus. The shadows of the internal and external ridges of the humerous superimpose. The faint serration indicates the line of separation of the capitellum. The shape of the radial epiphysis has broadened while its thickness has not increased, so that it is now a flat thin disk whose diameter approximates that of the shaft.

Our next slide showing the elbow a few months later presents the capitellum as a semi-spherical body whose anterior portion is more closely joined than the posterior part to the diaphysis. The secondary inner line is the lower edge of the trochlea superimposed upon the capitellum. The greater sigmoid cavity is now quite well filled.

The next change which we note is the appearance of a secondary centre for the epiphysis of the olecranon. This secondary nucleus is not always present, but it is often found, and its shape and position should be remembered as it might lead to confusion. Just below the primary centre can often be made out, as in this slide, a minute shading, which is to be interpreted as an off-shoot of the primary centre. Through a slight obliqueness of the rays we find the capitellum better differentiated from the trochlea. Above the capitellum is to be seen the nucleus for the internal condyle. When the rays are directly perpendicular to the joint, this centre is often not recognized, owing to its outlines being confused with the lines of the internal and external ridges.

We next note the union of the primary and secondary centres of the olecranon, effected by a slender deposit while the slight irregularity below marks the increase in the size of the third centre spoken of in the last slide. The shadows of the trochlea, capitellum and internal condyle are here superimposed so that their differentiation is impossible.

In the lateral view at fifteen, we note first the fusion of the separate centre of the olecranon into one large mass and the union of it to the ulna near the upper angle. The serrated ephyseal line has often been mistaken for a traumatic separation.

The trochlea and capitellum still show their line of demarcation. The internal condyle is barely distinguishable.

The antero-posterior or sometimes termed vertical views are perhaps a little plainer than the lateral ones just demonstrated. They are not so often seen in plates of injured elbows on account of the difficulty of the proper posture when tenderness is present.

In a vertical view of the elbow at six, we find the lower end of the humerus with most of its points rudimentarily outlined. The thinning of the shaft at the olecranon fossa is indicated by the lighter area, although the boundaries are indefinite. The capitellum is sharply outlined with its calcic deposits assuming the cancelous shape. The radial epiphysis is a small disk which stands out better than in the lateral view. The ulna presents only indications of the future development of the olecranon and coronoid process. There is no appearance as yet of the internal condyle notwithstanding the statement in our standard anatomies that it is present at the fifth year.

The prominent change in the next slide at nine years is the appearance of the internal condyle which shows as a semi-circular detached knob. The olecranon fossa is taking on the more characteristic shape which is later shown, the radial side being especially differentiated. The capitellum projects further toward the radius. The radial epiphysis is a much wider disk and its upper surface shows the hollow of the articular structure. The coronoid process is becoming more marked as shown by a dark streak. The trochlea is invisible.

The next important change is the widening of the capitellum. The external portion is superimposed over the shadow of the lower end of the humerus. The ulnar portion seems to project into the joint cavity. The olecranon fossa is more sharply outlined as the ulnar wall is more developed. Owing to the obliquity of the rays the coronoid projection has a more characteristic shape.

In the next slide at age twelve we find the shadow of the trochlea faintly indicated. The ulnar side of the capitellum has grown so that it approximates more toward the humerus. The internal condyle has increased and its inner edge is superimposed upon the humerus.

In the next slide we find the trochlea showing very distinctly. The line of separation between the capitellum and its diaphysis has diminished to a faint trace. The internal condyle is partially united. The radial epiphysis shows more of the concavity of an articular surface, while the epiphyseal line is much less sharply marked. The olecranon shows through the thinner olecranon fossa.

In presenting these few slides the writer has not always sharply indicated the age at which these various changes take place. The reason is that the development of the bony framework and especially that of the extremities while it conforms to a general rule is not always the same at the same age in different children. Just as we must not expect to always find the same height at a given age, so will we find variations in the development of the nuclei for the epiphysis. For purposes of surgical diagnosis it is not important to remember just at what age certain changes take place as long as we are familiar with those changes. In the paper presented before this society a few years ago the writer formulated the rule that it is always best to compare the injured joint, if possible, with the uninjured one. While an adherence to this principle will oft times be of great assistance, yet it will be found that the bony development of the two sides of the body is not always symmetrical. Changes, however, in this respect are infrequent and usually slight in the elbow, in contrast to the carpus where anomalies of development are often present, the right wrist presenting a different appearance from the left.

DISCUSSION.

Dr. Geo. E. Pfahler, Philadelphia: Dr. Hickey has presented us with a complete study of one joint. That work ought to stimulate some one else to make a similar study of some other important joint, and in due time we will have a complete study of every joint in the body, a study that will be invaluable for diagnostic purposes.

Dr. Gordon G. Burdick, Chicago: I was very much interested in Dr. Hickey's work, because it showed very plainly the

inefficiency of fluroscopic work in this connection. The men who are in the habit of using the fluroscope, diagnose as fractures almost everything that comes to them. In fifteen such cases, I was able to demonstrate the absence of a fracture. The development of the joint has not been appreciated properly, otherwise such mistakes could not be made. One boy, eight years of age, was wearing a plaster cast for a supposed fracture of the elbow, but none existed. I had to convince the surgeon of that by showing him a number of slides of normal elbows which showed exactly the same condition as that present in his case.

Dr. J. Rudis-Jicinsky, Cedar Rapids, Iowa: It is our duty to show the profession at large what we can do in this field. The anatomy of the development of the joints as printed in textbooks must be revised. It is incorrect and we can prove it with the X-ray.

Mr. M. I. Wilbert, Philadelphia: Those of us who were present at the Philadelphia meeting two years ago know that Dr. Hickey has devoted considerable attention not only to the elbow joint but to other joints as well. Of course, the elbow joint is one of the most important, especially in children and in young adults, because it is the most likely seat of injury.

There are few practitioners who can diagnose injuries of the elbow joint correctly, and, I am sorry to say, that there are X-ray workers who cannot do any better. They use the fluroscope which shows crevices in the joint of every child.

The pictures shown by Dr. Hickey are particularly interesting, elucidating the necessity of raying the elbow joint in two directions. We should always insist on that because the lateral view does not show the line of fracture in a number of instances, especially because epiphyseal separations are not rare.

Another thing should be insisted on, and that is the raying of both elbows. Frequently there exists a separation at the capitellum that is not very marked, or is not accompanied by a readily recognized injury to the bone itself. By raying both elbows the difference in tilt of the capitellum becomes evident, and thus a diagnosis can be made.

DR. G. P. GIRDWOOD, Montreal Can.: I wish to emphasize the necessity of studying the joint skiagraphically and not contenting oneself with viewing a picture on the screen, because in early life before the epiphyses have become attached or ossified, they may become detached, and such separations can be seen in the skiagraph and would be overlooked when using the screen.

DR. GEO. H. STOVER, Denver, Colo.: I do not use the fluroscope for the diagnosis of fractures, not only because it is dangerous to the operator, but because it is worthless. I want to emphasize the value of the stereoscopic skiagram. I use it habitually to diagnose bone injuries. In the case of the elbow I would not only make an anterior and posterior exposure, but also a stereoscopic exposure. It gives one a better idea of the relationship existing between the structures of a joint or of the condition in an injured bone than can be obtained in any other way.

DR. M. K. KASSABIAN, Philadelphia: I have difficulty in taking the elbow joint in the antero-posterior position on account of the difficulty of extension if the joint is fractured. To overcome this difficulty I use a small device, an acute angle splint which I place in the crotch of the flexed arm. The tube is placed on the olecranon side and the plate on the inside of the joint, thus getting better results than by placing the joint itself on the plate as is usually done.

DR. HICKEY (closing the discussion): I consider the fluoroscope a dangerous toy, and I never employ it. Besides, you can make more mistakes with the fluoroscope than with any other method of diagnosis.

With regard to the epiphyses of other joints, I have made quite a study of them recently which will be published shortly. The surgeons are beginning to be interested in this subject, and I was asked to contribute an article to a surgical text book on the appearance of the epiphyses from a surgical standpoint.

With regard to the radiography of the elbow, I mentioned the diaphragm. By that I mean the Schoenberg type of dia-

phragm. Its use is of the utmost importance for a correct interpretation of the elbow.

The use of the stereoscope is of great advantage.

I have not found many traumatic separations. Where there is enough violence to cause a separation, there is usually some fracture in the epiphysis.

Roentgen Diagnosis of Disease of the Lungs

BY G. E. PFAHLER, M.D.,
Philadelphia, Pa.

The importance of Rœntgen examinations of the lungs is well expressed by the statement of Dr. Judson A. DaLand, who says: "No chest examination is complete without an X-ray examination." In order to make Rœntgen examinations of the greatest possible value, the best technique and the most careful and accurate interpretation must be employed.

We as experts in this special branch of medicine have made great strides in the perfection of our technique. Even with the most perfect technique in the making of a negative, still much general knowledge of medicine, and much experience is needed to interpret accurately the shadows obtained. Much assistance can be had from the reading of the literature, but much more can be learned by the actual study of the negatives of the various pathological conditions, associated with the clinical or the postmortem findings.

Postmortem examinations are seldom made immediately after the Rœntgen examination, and in many of our cases they are never made. No one of us has therefore seen explanations of all the shadows obtained in our negatives. Neither has any one of us had the opportunity of studying all of the pathological conditions that we may be called upon to examine. Therefore, I have decided to present before this body a number of Rœntgenograms showing a variety of pathological conditions of the lungs, and give my interpretation. In many instances I know that my interpretation is correct, but in others some of my colleagues may differ with me. It is with the hope of bringing out criticisms and thus combining our experience in the study of diseases of the lungs, that I present this subject.

Fluoroscopic examinations of the lungs have been made almost since the discovery of the Rœntgen Rays, but the actual progress in the Rœntgen diagnosis of diseases of the lungs dates from the beginning of short exposures. In this field excellent work has been done by Hulst, Hickey, Kassabian, and others.

In order to study the lungs accurately the negative must be made while the lungs are at rest, or in other words, must be made while the patient holds the breath. This will usually be from three to fifteen seconds.

I have succeeded in making several good negatives of the chest of a child nine years of age in one-tenth of a second. Such short exposures are not necessary in the study of the lungs, but are necessary for the accurate study of the heart.

As a rule a careful physical examination should precede the Rœntgen examination, not because it will modify the shadows, but because it will enable the Rœntgenologist to interpret those present and may modify the method used, and thus make a second examination unnecessary.

The greatest field of usefulness of the Rœntgen Rays in lung diseases is in the study of tuberculosis. Here the lesions can be recognized earlier and more accurately than by any other method. Besides assisting in making a diagnosis, it is the most valuable and the most accurate method of recording the lesions at the various stages of the disease. It thus enables the physician to estimate the value of his therapeutic procedures.

Method of Making the Examinations. I have practically discontinued the use of the fluoroscope, because of its inaccuracy and because of the dangers attending its use. By the use of the modern devices for the protection of the operator at least one of these objections can be removed, still I feel that a fluoroscopic examination is not necessary.

Generally a negative should be made with the plate posterior to the patient and another with the plate anterior to the patient, so as to give proper value to any lesions lying near to the surface, and so as to recognize any thickening of the pleura. As a rule the patient should be placed in the recumbent posture, except when pleural effusion is suspected, in which instance the patient should be examined in the sitting posture. The tube should be

placed at a distance of 18 to 20 inches from the plate. The time of the exposure will vary with the time that the patient can hold the breath.

This time should be accurately determined by testing the patient several times before attempting to make the exposure.

Interpretation. The proper interpretation of the negative is more important and as difficult as the making of it. The negative itself should be used for study.

Old calcified tubercles give the most decided shadows, and lesions of this kind can be recognized as small as one-eighth of an inch in diameter.

Old scars or fibrous tissue cast a less dense shadow and require larger lesions, but they can usually be recognized by their band-like appearances.

Consolidations vary in the density of their shadows with the size of the lesion; but an area one-half inch in diameter can be recognized in an emaciated person. In one patient, who was very much emaciated as the result of tuberculosis of the peritoneum, I succeeded in showing little tubercles the size of a pinhead. Consolidations seldom occur singly, therefore they give the lung a mottled appearance, except when there is massive consolidation. Finally the consolidation can be recognized by comparison of the suspected area with that of the opposite lung or with the other parts of the same lung. The tubercular deposits, or the affected areas lying in different planes, are thrown upon the plate in one plane. Therefore upon superficial observation one might conclude that a greater proportion of the lung is affected than is correct. That is, the whole lung might show a mottled appearance, and the false conclusion be drawn that no healthy lung remained. This mistake need not be made by an experienced observer, because if the whole lung or lobe is involved the degree of general density will be much greater than when only scattered areas are involved, and the density will approach that of the shadow of the heart. Even when a whole lobe is involved, the shadow is rarely uniformly dense, because the lung is rarely uniformly consolidated. There are likely to be small or large areas of cavity or compensatory emphysema associated.

Fig. 1.—Child nine years old. Exposure one second. Plate eighteen inches from anode. Posterior view. Shows consolidation of the lower and posterior portion of the left upper lobe. The child had no symptoms referrable to the lungs. Note the absence of a sharp line of the heart shadow.

Cavities are usually recognized by their increase in transparency surrounded by the shadow of consolidation. If the cavity is large there will be little difficulty in recognizing it. If, however, the cavity is small or is resting upon a large area of consolidation or thickened pleura it is less easily recognized. Under favorable circumstances, a cavity one-half inch in diameter can be recognized.

Emphysematous areas are also noticeably transparent. A dense shadow may be found on one side of this area, but it is likely to have the other side continuous with more or less healthy lung tissue, and therefore can be differentiated from a cavity.

Pulmonary Abscess. This diagnosis can not be entirely made by means of the Rœntgen Ray, but when it is suspected, it can be more accurately located by the assistance of the rays. The radiographic appearances will not differ materially from those of cavity, except that the surrounding area of consolidation is likely to be larger in proportion to the size of the cavity. Since the two may be associated, however, the difficulties are increased, and the findings must be carefully compared with the physical signs before operating.

Pulmonary Gangrene. The remarks made above in connection with pulmonary abscess will apply to pulmonary gangrene, except that instead of the area of consolidation being large and the cavity small, in this instance the cavity is more likely to be large and the surrounding wall small. The conditions and the shadows will vary with the stage at which the examination is made. The odor will usually suggest the diagnosis, and the rays will be useful in locating the area for operation.

Pneumonia. The fluoroscope shows a dense shadow in the affected area, and the movements of the diaphragm are diminished on the affected side, partly because of the increased density of the lung and partly at times because of an adhesive pleurisy. Williams was one of the first to apply the rays in the study of pneumonia. He depended almost entirely upon the fluorescent screen. De la Camp has recently made some interesting studies in pneumonia, in which he used the plate. (Fortschritte and Gebiete d. Rontgenstrahlen, April 30, 1905.) He finds that the rays will more accurately localize the lesion than can possibly

be done by any other means. This is especially true when the lesion is centrally located, or at a distance from the surface. It is in this class of cases that the rays will be found most useful, because it is in them that ordinary physical signs so commonly fail.

It is also a most useful adjunct in the diagnosis of lesions not centrally located, especially when such lesions are situated beneath the scapula, or when small consolidations are surrounded by areas of compensatory emphysema. Compensatory emphysema assists in outlining the lesions by means of the Rœntgen Ray because of its greater transparency; but offers considerable hindrance when the ordinary physical signs are depended upon. De la Camp found even in lobar pneumonia that the whole lobe is seldom uniformly consolidated. He often found by means of the rays an extension of the process into another lobe or into the opposite lung, when ordinary physical examination failed to reveal such lesions.

He also found the rays of great assistance in the study of the cases during the stage of resolution. In some cases, months were required for the lung to completely recover. The rays show lesions long after the physical signs are negative. In one case in which the patient complained of pain in the region of the heart, which persisted four months after the crisis, and after all physical signs were negative, the Rœntgen examination showed a fibrous band about one-fourth of an inch broad binding the left side of the diaphragmatic pleura to the pericardial sac. Other symptoms of obscure origin following pneumonia may often be cleared up by the aid of a Rœntgen examination. The same principles that have been described in the interpretation of tubercular negatives will apply to those of pneumonia.

The areas involved, however, are usually larger and therefore more easily recognized.

Emphysema. In a typical case of emphysema one is struck by the great transparency, which is greater than in any other condition of the lungs. This transparency affects both lungs, as a rule. The ribs will be found to extend outward from the spinal column at more nearly a right angle than normal. To distinguish the lesser grades of emphysema, or to recognize local

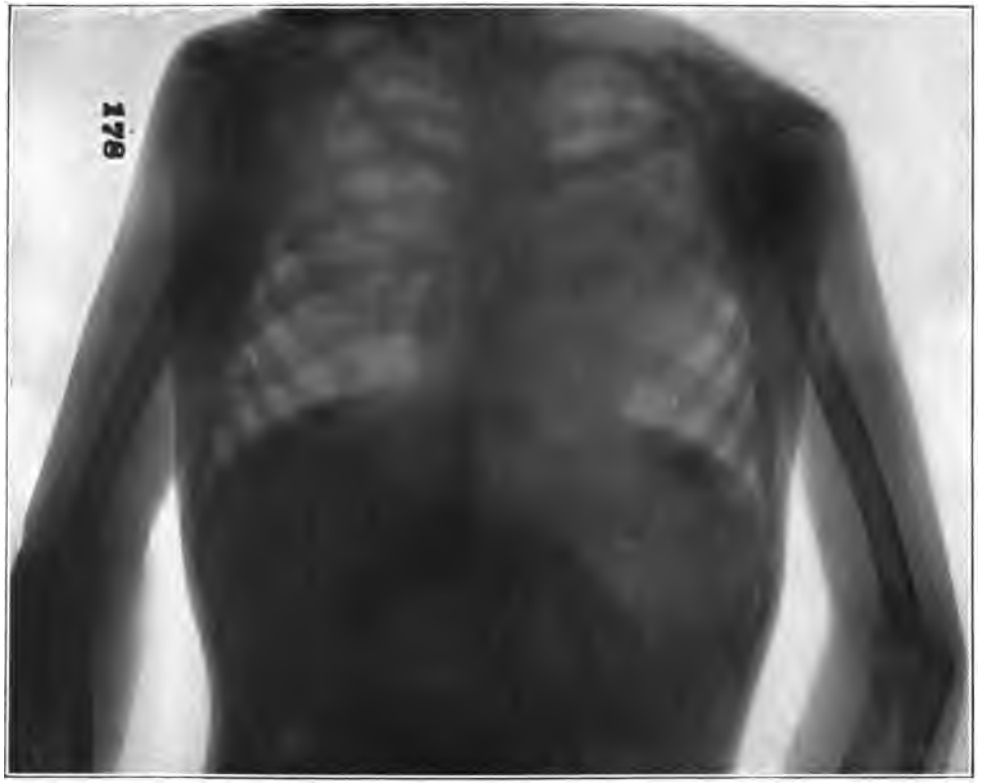

Fig. II.—Anterior view of the same case as in Fig. I. Made in one-tenth of a second, to get an outline of the heart in a period of rest. Heart was beating one hundred and twenty per minute. Note the sharp line of the heart; the tubercular consolidation as in the previous case, but less definitely outlined.

areas much more experience is necessary. For then one must keep in mind the normal Rœntgenogram of the same age and general development, thickness of the chest walls, etc., and made under similar conditions.

Collapse of the Lung. Collapse of the lung will probably not be recognized by means of the Rœntgen Rays when the area involved is small, but when the area is large it gives an appearance very similar to that of consolidation. It is more uniform and more sharply outlined than in tuberculosis, and it involves a lesser area than when pneumonic consolidation is present.

Thickening of the pleura is a common affection occurring both independently and in association with tuberculosis of the lungs. This condition is recognized in the Rœntgenogram as a uniform shadow of only slight density. The density will vary with the degree of thickening. This shadow is then seen to shade gradually at its edge into the surrounding clear space. If the surrounding lung is healthy there will be little difficulty in recognizing a moderate thickening.

If, however, the thickened pleura is overshadowed by consolidated lung it becames much more difficult and at times impossible. Here experience alone will serve as a guide. In order to study the pleura accurately, both an anterior and a posterior plate should be made.

Pleural Effusion. Pleural effusion is best recognized by placing the patient in the sitting posture, with the plate or screen posteriorly and the tube anteriorly. To make a Rœntgenogram, place the patient in a chair with a large board resting against the back, and upon which the plate is supported. The pleural effusion gives a uniform but not a very dense shadow occupying the lower part of the pleural cavity. The upper level has a curved but not an irregular line. In uncomplicated effusion the shadow is even more uniform than that of a thickened pleura. The pleural thickening will also be recognized by its irregular border, which is never a line. The shadow is less dense than would be produced by consolidation of the lobe of the lung.

Pneumothorax. Pneumothorax is recognized by the area of great transparency—greater than emphysema. This area is elongated in a vertical direction, as a rule, and occupies the lower

lateral portion of the chest. Toward the median line may usually be seen the thickened pleura and the diseased lung. The heart is commonly displaced to the opposite side.

Hydro-pneumothorax. This condition is more common and forms one of the most interesting fluoroscopic pictures that can be found. In addition to the findings of pneumothorax, the fluid at the base of the pleural cavity may be seen to move with each respiration or each movement of the body. If the patient is shaken, the fluid is seen to splash.

Haemothorax. I have examined two cases of this character. Both showed a more dense shadow than would be produced by any other form of pleural effusion.

Consolidation and Pleural Effusion Combined. In a case of this kind, the shadow of the pleural effusion was seen to extend to the fifth rib on the right side and to the seventh rib on the left side. The consolidation of the right middle lobe showed through the effusion, and was distinctly more dense. Probably no condition will give more difficulty in recognition than consolidation surrounded by an extensive pleural effusion. In this particular case we had that peculiar physical sign, viz: tubular breathing and bronchophony extending throughout the area of pleural effusion. By making Rœntgen examinations in all such cases we may find that consolidation of the lung is present and that it is the cause of the peculiar physical sign. This sign is probably due to the transmission of the larger sound waves from the bronchi, though the consolidated lung to the fluid in the pleural cavity, and thence through the chest wall to the ear. The striking of two stones together will convince most people that fluids will transmit sound, but these sounds must be of the louder and coarser variety, therefore vesicular breathing is not transmitted through an effusion.

Subphrenic Abscess. The difficulty in recognizing many of these cases is appreciated by all who have had much experience, and therefore any aid will also be appreciated. In a case examined about two years ago, by means of the screen I was able to see a decided displacement of the diaphragm upward as far as the ninth rib, and absolute immobility was noted on the right side. The left side of the diaphragm was seen to move two and one-half inches. The Rœntgen examination will also eliminate

Fig. III.—Physician. Posterior view. Exposure 11 seconds. Shows tubercular infiltration of both apices with scattered deposits below. Shows collapse of the lower portion of the right lower lobe.

some of the diagnoses with which this condition may be confused, such as pneumothorax, encysted pleural effusion, or empyema.

In general, the diagnostic value of the evidence obtained through the Rœntgen Ray will depend very much upon the skill and the experience that the operator has had both in Rœntgen work and in general medicine. Glowing reports of cases, beautiful Rœntgenograms, and the enthusiastic claims of manufacturers lead many physicians to conclude that all they require to get good results is an instrument. This is as absurd as to conclude that all a physician needs to enable him to do good surgery is a set of good surgical instruments. Much harm has been done both in diagnosis and in treatment by the possessors of this erroneous idea. Much skill both in the preparation and the interpretation is needed. This is obtained only through daily practice. The ability to read a negative will also depend in great part upon the physician's knowledge of general medicine.

DISCUSSION.

DR. P. M. HICKEY, Detroit, Mich.: I have been very much interested in the chest pictures, and the Doctor is to be congratulated on having shown such perfect specimens of work. I would like to ask him whether he can explain the peculiar outline of the heart that is seen in cases of advanced tuberculosis. I find that often I can make a probable diagnosis of tuberculosis from the appearance of the heart.

DR. HENRY HULST, Grand Rapids, Mich.: For several years I have been interested in the diagnosis of tuberculosis of the lungs in the prebacillary stage of the disease. In 1889 Reider showed the first good pictures of the chest and published some in his atlas in 1902. When I began this work I was obliged to use long exposures and found that macroscopic lesions showed very well, but not minute new lesions. Of course, I could easily imagine things, that one apex was a little more opaque than the other, but I did not get enough detail to make a diagnosis. I felt that if I could make a picture in a short enough time I could get all the detail I wanted.

About three years ago I succeeded in doing that, and since then I have never exposed a chest for more than one second. You must do that in order to get detail of soft tissues. I find that a good picture of the lung will show much fine veining in every normal lung and one not accustomed to this appearance might mistake this for tuberculosis when there is none there. It is the character and distribution of this detail that is diagnostic.

The time exposure eliminates that all together. If you have a lung with one apex infiltrated, you will get richer veining and mottling in that apex; but when you get that rich detail all over both lungs you may mistake it for tubercules when there are none there unless momentary exposures have accustomed you to this appearance.

I have heard the objection raised that these quick exposures make thin negatives. That is not necessarily true, but is due to defective technique always.

Incipient tuberculosis in the absolute sense of the words cannot be diagnosed by any means at our disposal. It is only after changes are present that the rays can record them. When you do get a positive Rœntgenological diagnosis of early pulmonary tuberculosis it is the most incontrovertible diagnosis you can get. A negative diagnosis is really only of relative value. I would never tell a patient that he did not have tuberculosis simply because I could not find it. I should merely say that I did not find any evidence of the disease.

Dr. J. Rudis-Jicinsky, Cedar Rapids, Ia.: When in 1897 I read a paper before the Nebraska State Medical Society on the X-ray diagnosis of pulmonary tuberculosis, they all laughed at me. I wish those gentlemen could see the beautiful negatives that Dr. Pfahler showed us today.

I have made a plate of one case of abscess of the lung. The surgeon in the case told me that the negative was very nice, but he did not believe in what it showed. He knew that the case had been photographed for his benefit and that he introduced a needle into the supposed abscess but failed to get even a drop of pus. On inquiry I learned that he had introduced the needle on the left side when the negative showed plainly that the abscess was located on the right side.

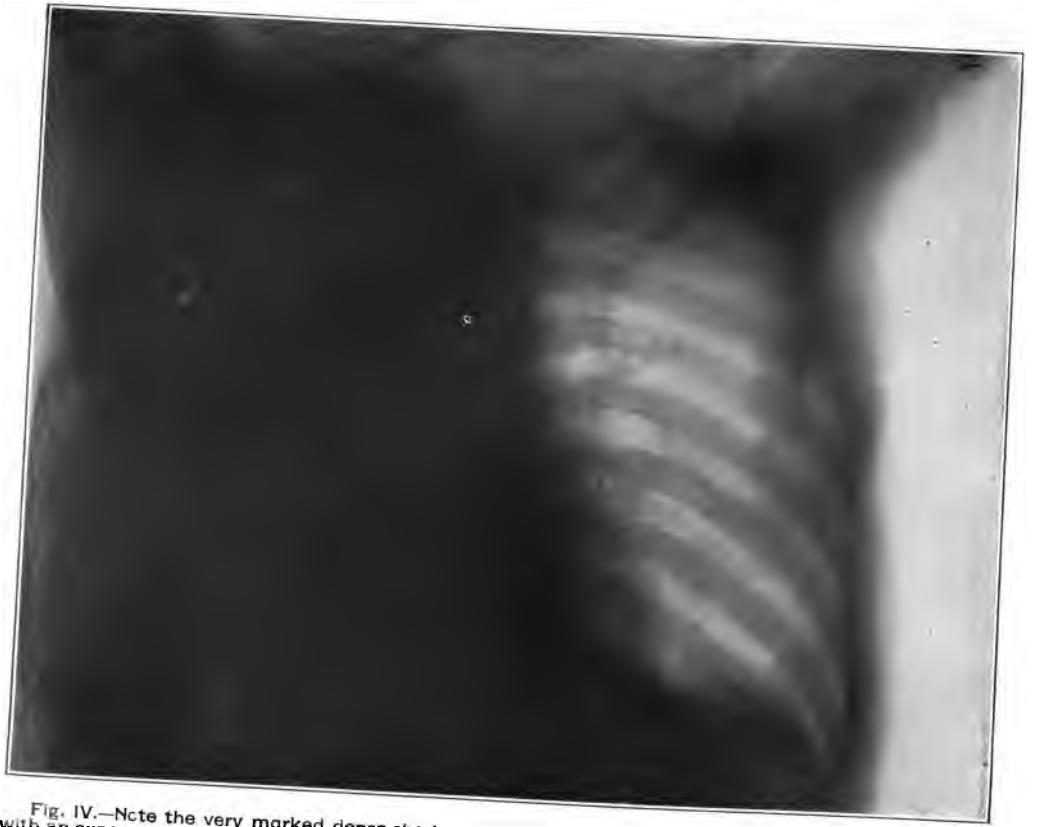

Fig. IV.—Note the very marked dense shadow involving the entire left side of the thorax. Made in 1901 with an exposure of two and a half minutes.

DR. M. K. KASSABIAN, Philadelphia: As we are making such rapid exposures, why should we not take stereoscopic pictures? Then we can distinguish consolidation from pleural thickening, cavitation from consolidation and from other conditions. A thickening is shown due to the muscles on the right side of the chest being better developed than those on the left side. In the female the mammary gland throws a shadow that must be taken into consideration.

DR. PFAHLER (closing the discussion): I cannot explain the peculiar position and appearance of the heart to which Dr. Hickey referred.

With regard to the fine detail referred to by Dr. Hulst, I probably gave the wrong impression. The lines he referred to I did not interpret as tubercle. I believe those are caused by small bloodvessels, although I am not positive. I do know, however, that those little localized shadows are tubercles, and in one case my diagnosis was confirmed at the autopsy. There may be no physical signs and no symptoms of tubercle, yet by comparing several of these negatives and finding these little shadows, we will be able to interpret them correctly.

As to the stereoscopic examinations, I wish they could be made, but I have never heard of anyone making a stereoscopic examination of the lung that showed anything, for the simple reason that you cannot make your patient stop breathing twice at the same point, at least, I have never been able to do so.

The X-Ray Diagnosis of Thoracic Aneurisms

BY FREDERICK BAETJER, M.D.,
Of Baltimore, Md.

In the ten years that have elapsed since the discovery of the X-ray all branches of medicine have been benefited by this new diagnostic agent. In no one branch, however, has as much light been thrown as upon the chest and its diseases; especially true is this of the heart and its appendages.

Heretofore with the means at our disposal the diagnosis of aneurism was often difficult and sometimes impossible. In the very early cases just when the most good could be done aneurisms would be overlooked and probably not recognized until the size would preclude almost any hope of doing good. Especially true is this in strong muscular men at about the fourth decade of life who have degenerative processes in the walls of the arteries due to syphilis or alcohol. On the other hand, a diagnosis of aneurism may be made which would of necessity cause an absolute change in the patient's habits and mode of living, and yet the subsequent history or possibly the autopsy would show that all the patient's care and anxiety were needless as no such pathological condition had existed. Since the discovery of the X-ray this doubt and uncertainty has been removed and now we can practically make an absolute diagnosis both positive and negative.

The two methods at our disposal, radiagraphic and radioscopic, give us an accurate knowledge of the chest and its organs. Whereas the radiograph gives a permanent record and reveals more detail, yet the examination by the fluorescent screen gives us a more comprehensive knowledge of the chest. By means of it we can examine the chest from various angles and see the actual pulsations of the heart and its vessels. In this hospital

the value of this method of examination has become so apparent that is has become practically a routine to examine every obscure chest disease.

Briefly, the method of procedure here is as follows: Before proceeding with the X-ray examination, the patient is examined to see that there are no abnormalities as to the formation of the chest or spine due to some disease. For example, a diseased vertebra may push the aorta aside and the condition simulate that of an aneurism. In rachitic children it is common to see a pulsating tumor to the left of the sternum simply due to a displaced arch of the aorta.

Having assured ourselves that no abnormalities exist, the patient is placed in a sitting position with his back to the tube. The tube is placed at the level of the third rib and from twenty to twenty-four inches away. At this distance there is very little divergence of the rays and consequently the image projected upon the screen is not materially enlarged or distorted.

After this examination has been made, the tube is placed in front at the same level and the patient is examined from the back. By means of these two positions we can locate the position of an organ by comparing the size of the shadows in each case, since the shadow is always larger the further it is removed from the screen. Now by means of transverse, or slightly transverse illumination we can frequently tell whether the object has its attachment in front or behind. This in especially important in determining whether an aneurism springs from the ascending or descending portion of the aorta.

Before leaving the chest it is well to make an examination both from in front and behind with the tube placed on a level with the end of the sternum. By having these fixed positions of examinations we get a composite normal and one soon learns to tell any variation from this normal.

The objection may be advanced that this method does not give an absolutely true picture of the chest because the tube and screen are not always in the same plane. By making the examinations at two different levels the objection is obviated and our composite picture is a true one as the records of the physical examinations and autopsy reports in this hospital have shown.

In a normal individual the fluorescent screen reveals the following picture. The lung substance being permeable to the ray gives us a clear view of the clavicles, scapulae and ribs. In the median line we have a dark band about two inches broad extending downward from clavicular articulations to be lost in the shadow of the heart. This is caused by the spine and sternum. On the left side, low down, the pulsating heart can be readily made out, its shadow fusing into that of the diaphragm. On the right side a slight pulsating shadow due to the right heart and beneath is the shadow of the right diaphragm. Since the aorta lies just above the spine its shadow is obscured by that of the spine and sternum and consequently no pulsation can be seen either to the right or to the left of the sternum. This practically always holds true. In very thin individuals, however, occasionally a slight pulsation of the arch may be observed but this is rare. In only one per cent. of the cases has this been observed. Abnormalities causing displacement of the aorta have already been mentioned.

From what has been said we can assume that any shadow existing either to the right or to the left of the sternum is abnormal. This may be due to a variety of conditions, such as:

I. New growths.
II. Enlarged glands.
III. Displaced aorta.
IV. Dilatation of the aorta.
V. Aneurism of the aorta.

In new growths and glandular enlargment the history of the case is important and then, too, the shadow cast is more dense than one cast by an aneurism. Absence of pulsation is of value but cannot always be relied upon, as frequently we get a transmitted pulsation which can scarcely be distinguished from that of an aneurism. The two distinguishing features, however, are that the shadow is darker and the edges are more hazy and irregular.

Displaced aorta can be ruled out by examining spine and chest to see that there are no abnormalities.

In dilatation of the aorta distinct pulsation of the shadow can be seen but the diagnostic point is that the shadow disappears

between pulsations because the aorta contracts in this condition and its shadow lies within that cast by the sternum and spine. In this connection I may say that especially in such cases is the examination by the fluorescent screen of more value than the radiographic. The radiograph may show no shadow if taken between pulsations or if taken during pulsation show one. In either case a false interpretation of the condition would be made. Aneurisms where the sac is large and pulsating offer no difficulties as to diagnosis.

The detection of small aneurisms just when an early diagnosis is of such value to the patient is often difficult. The one point to bear in mind is that a pulsating shadow which does not disappear between pulsations, should always be viewed with grave suspicion. Very small aneurisms can be diagnosed as evidenced by case 74 which we will consider later.

Broadly speaking, aneurisms may be divided into two classes; namely, sacculated and diffuse. The sacculated ones offer but little difficulty of diagnosis. The shadow pulsates and stands out as a rounded mass from the sternum.

Diffuse aneurisms where the aorta is uniformly enlarged, are marked by a broad shadow extending down along the sternum, generally on both sides. The distinguishing feature, as spoken of before, is that the shadow persists between pulsations.

Naturally, the appearances vary greatly and depend upon the size and position of the aneurism. Roughly speaking, the positions may be classified as follows:

I. Aneurism of the descending portion of the aorta usually casts a shadow more to the right than to the left of the sternum, above the heart, and by localization would be found to be nearer the anterior than the posterior wall of the chest.

II. Aneurism of the arch casts a shadow slightly to the left of the sternum and this shadow extends well up into the neck and by localization would be found nearer the anterior chest wall.

III. Aneurism of the descending arch of the aorta casts a shadow to the left of the sternum and by localization is generally nearer the posterior than the anterior chest wall.

The above classification covers the common situation of aneurisms, though they may occur anywhere in the course of the thoracic aorta. The records of this hospital show one case where the aneurism arose from the aorta just before it passed through the diaphragm. The heart was displaced upward and outward and just below to the left of the median line a large pulsating mass the size of an orange could be readily seen. The movement of the left side of the diaphragm was markedly inhibited. The interesting feature in this case was the fact that the patient had been sent to the hospital as a case of rheumatoid arthritis of the spine.

Since practically all obscure chest conditions are examined in this hospital as a routine, we will not take into consideration those cases in which no aneurisms were found but will confine ourselves entirely to those of aneurisms.

In the past four years there have been 104 cases in which a positive diagnosis of aneurism has been made. These cases extended over a wide field; some were found by accident, in others the signs were suggestive, and still another class where both signs and symptoms pointed to aneurism.

A brief mention of some of the unusual cases may be of interest to this Society.

Case 68 is of interest on account of absence of physical signs and a diagnosis of intercostal neuralgia. The patient was a man aged 45; complained of pain in left side and loss of weight. Onset was one year ago with pain in right lower thorax radiating to the spine, worse on exertion and paroxysmal in character. This pain gradually increased in intensity and frequency of attack. Entered hospital in one of the Southern states and there diagnosed intercostal neuralgia.

After leaving hospital symptoms increased with the addition of weakness and some dyspnoea. He came to this city to consult Dr. Osler. The physical examination was absolutely negative for aneurism. Dr. Osler referred the patient to me for an X-ray examination, and a large, well-defined aneurism of the ascending aorta, size of an orange, was discovered.

Case 71. Woman, aged 23. Complained of shortness of breath. Onset of trouble five weeks ago with cough and short-

ness of breath. Symptoms increased, accompanied by severe attacks of dyspnoea. Patient admitted to the hospital in service of Dr. Osler. At that time marked respiratory distress and cyanosis. Physical examination of chest negative, except for harsh breath sounds due to labored breathing. Diagnosis—some obstruction to trachea, either external or internal, due probably to new growth.

X-ray examination made and diagnosis of small aneurism of transverse arch of aorta springing backward and causing tracheal pressure. Patient improved for a time, when suddenly patient became worse, became unconscious due to asphyxia. She was immediately seen by Dr. Halsted and, as obstruction seemed below larynx, he did a tracheotomy and introduced a rubber tube to a point 15 cm. below tracheal wound. This gave immediate relief. Exploration of mediastinum was deemed advisable. A portion of sternum and ribs was removed and mediastinum well exposed but a hasty exploration revealed no tumor. Patient died that afternoon and autopsy showed a very small aneurism coming from the transverse arch, going backward and pressing on the trachea.

Case 84 illustrates the bad results of a late diagnosis. Patient a man of 65. Complaint, shortness of breath and respiratory distress. Illness extends over a period of ten years. Seen seven years ago by a prominent consultant who diagnosed case as asthma. Patient never improved to any extent. Two months ago voice became husky and indistinct, due to a recurrent laryngeal paralysis. With the exception of the asthmatic condition, chest was negative. X-ray examination revealed one of the largest aneurisms I have ever seen. It practically filled the entire upper left chest.

Case 100 is interesting on account of the peculiar symptoms. Man, aged 57. Complaint, pain in back, side, stomach and chest. Three years ago patient had a gall stone operation done for these symptoms. No gall stones were found and symptoms did not disappear. One year after operation shortness of breath came on. Came to this hospital and the marked pain and rigidity of spine suggested spondylitis deformans.

The physical examination of the chest was practically negative. There was a slight pulsation in the second intercostal space but was attributed to an enlarged mammary vessel. To definitely rule out aneurism, however, patient was referred to X-ray department, where a large aneurism of the descending portion of the aorta was found.

The question naturally arises in how many of these cases has the subsequent history proved the diagnosis of aneurism to be correct. Of these cases 70 to 75 per cent. were referred to the X-ray department by the medical side with a definite diagnosis of aneurism. The position and size from the X-ray findings practically always agreed with the medical finding; 20 to 25 per cent. the diagnosis was doubtful, but in many of the cases the subsequent history proved the X-ray diagnosis to be correct. In 5 per cent. of the cases the aneurism was found by accident, there being no physical signs.

Of all these cases 18 per cent. came to autopsy and the anatomical findings corresponded exactly to the X-ray findings.

Naturally, in the class of cases that come to a hospital many are finally lost sight of and final proof of the diagnosis cannot be obtained.

The value of the X-ray examination is so apparent in such conditions that it needs no one to urge its claims. Dr. Osler believes that an X-ray examination of the chest should be made in all obscure cases.

In conclusion, let me quote Williams, who sums up the situation so admirably: "X-ray examinations should always be made. Normal outlines in the upper part of the chest give us the best assurances that an aneurism of the aorta is not present, though symptoms may obtain which lead the physician to suspect it. On the other hand, if an aneurism be present, its outline will be demonstrated by the X-ray examination. An outline suggestive of aneurism may be due to other causes, as new growth, for example. But confusion of this kind is not common and we can in most cases convince ourselves by a careful examination whether or not it is an aneurism which casts the shadow. X-ray examinations enable us to determine the extent of an aneurism more accurately than the usual physical exam-

ination, and to detect its existence at a much earlier stage. Successive examinations enable us to determine whether or not it is increasing in size.

"To make a definite diagnosis of aneurism by the usual physical examination we may be obliged to wait for the development of marked signs and this delays treatment. On the other hand, if the physician begins treatment because the signs are suspicious, he runs the risk of subjecting his patient to unnecessary regimen. The advantages of X-ray examination when compared with the usual physical examination are evident. A definite diagnosis can be made in most cases before there are physical signs. Treatment can therefore be begun at an earlier and more hopeful stage, can be planned more intelligently as the knowledge of the position and extent of the aneurism is more accurate and its results can be better estimated because we can more accurately measure any change in size."

DISCUSSION.

DR. P. M. HICKEY, Detroit, Mich.: The large number of cases the doctor has shown us certainly forms a most interesting collection and it is deserving of a prominent place in the literature, especially since the results obtained have been so definite.

The Rœntgen Ray diagnosis of aneurisms is a very important one. My experience has convinced me that the most disastrous results follow a disregard of such a diagnosis. I remember one case where the surgeon disregarded the Rœntgen Ray diagnosis of aneurism and proceeded to operate for a supposed mediastinal tumor, with the result that the patient died on the table. In another instance, where there was the absence of physical signs of aneurism, although the radiograph distinctly showed the shadow, the patient was sent West on the supposition that he had tuberculosis. He died on the train from rupture of the aorta caused by the high altitude.

DR. GEO. C. JOHNSTON, Pittsburgh: My experience in the diagnosis of aneurism by means of the Rœntgen Ray has been a limited one, but I have had two inquiries from physicians who were sufferers from aneurism, both of whom told me that they

had been treated by the Rœntgen Ray for aneurism of the aorta, asking me what technic should be employed. I replied that I was absolutely unable to suggest any technic.

I cannot see the sense of the treatment of aneurism by the Rœntgen Ray, but when even the profession can deceive itself into the belief that this agent could have any effect on aneurism, it is not difficult to understand how the public can make such a mistake.

Dr. W. S. Newcomet, Philadelphia: As a rule the fluoroscope is much neglected, and ever since I first started in this work I have always been the advocate of the use of it. The main thing is to know how to guard against a burn. One must be extremely careful while using the fluoroscope and never get in front of the ray, without the protection of a proper shield. With the aid of this apparatus we can see conditions in the chest that cannot be seen in the best radiograph. At the same time, we can make rapid successive examinations for comparison, and small records of the case can be made by having a pantograph handy. These can be pasted on the history sheet and thus form a valuable addition to the clinical data. To avoid the danger of burns, get through with the examination as quickly as possible, not exposing either yourself or the patient any more than is absolutely necessary.

The use of the fluoroscope is well exemplified by the following instance: Some time ago a most interesting dispute arose over a man suffering from a chest lesion. His symptoms were misleading in many ways, and he was supposed by most of the physicians who had studied his case to have a pleural effusion which occupied the left chest, reaching to the lower border of the second rib, while the heart was pushed over so the right border was at the right auxiliary line. The dullness did not change to any great degree by moving the patient, and the supposition was that the fluid was encysted. The physician who brought the case to me suspected a malignant growth in the chest. A radiograph was made, and also on several occasions he was examined with the fluoroscope and it was by the use of the fluoroscope that we were able to convince several of the physicians who had previously seen him that it was a tumor

and not an effusion, notwithstanding the fact that at least 18 or 20 unsuccessful attempts at tapping had been made. The lung could be seen opening and closing with inspiration and expiration below the line of the tumor.

The man died, and I was fortunate enough to get permission to perform an autopsy. I found a tremendous mass in the chest, springing from the pedicle of the diaphragm. The mass measured 10 inches in one direction and 16 inches in the other. This case illustrates the value of the fluoroscope and the absolute impossibility to make a correct diagnosis with the radiograph alone. The ordinary fluoroscopes used are not large enough for this kind of work and it is a very difficult matter to get a good fluoroscope. The most essential point is to have one large enough to show the entire chest, and not the small apparatus usually used. The whole chest must be seen on the screen for it is the gross picture that is studied, relative position of the different organs and their movements, while for the finer details we must use a radiograph made under proper conditions.

DR. PANCOAST, Philadelphia: Before Dr. Baetjer read his paper, it was thought that he would so strongly favor the use of the fluoroscope that much objection would be raised against his method of examination, but I think he has convinced us that this instrument has some value in the diagnosis of aneurism. There is nothing more dangerous in X-ray work than the fluoroscopic examination, and the greatest care should be observed in the use of the instrument. A fluoroscopic examination is essential in distinguishing between a dilatable aorta and an aneurism. Unless a snap-shot picture were made the former would have an appearance on the skiagraphic plate exactly like an aneurism.

DR. HENRY HULST, Grand Rapids, Mich.: I enjoyed the paper very much and also the discussions. I think it is well to have all sides of the question brought to our attention, but in doing so we are too apt to be emphatic and fail of our purpose. The impression may have gained ground that I have no use for the fluoroscope whatever. On the contrary, I believe that it is just here, in the examination of the chest and the heart, that the fluoroscope is very valuable. In fact, I never make an ex-

amination of the chest without using the fluoroscope. You cannot get the phenomena of motion with the skiagraph that you can get with the fluoroscope.

For instance, in the diagnosis of aneurism of the aorta, Holzknecht has pointed out that by making the rays pass between the spinal column and the pulsating mass, you can see whether the bulging of the aorta is due to aneurism or to something else. By viewing it in that oblique way, the aneurism will show as a fish-shaped or club shaped shadow. Many a picture taken in the dorsal position resembles that of an aneurism, though none is there. In the oblique view you can see that you are looking at a large aorta.

It is, therefore, in the diagnosis of diseases of the chest, and especially of the heart, that the fluoroscopic examination is valuable. On the other hand, I must take exception to what Dr. Newcomet said, that we can see more with the fluoroscope than on the plate. I think you will agree with me that that is over stated. If you have ever tried to look for some small object in the foot, like a needle or a nail and failed to find it with the fluoroscope, though the skiagraph revealed it at once, you will need no further proof to show that the plate is a better instrument than the eye.

If you want detail, if you want to see minute changes in the lung, use the plate. If you want to examine the chest in all positions, if you want to see what respiration does, what motion does, use the fluoroscope. In the examination of the bones you can dispense with the fluoroscope, but in an examination of the lungs, you should always use the fluoroscope. The danger is greatly exaggerated. If you use lead glass and have the tube arranged so that the rays will not strike you, especially if you will protect your body by a good apron, you can examine your patient to your heart's content without any danger to yourself.

Dr. J. Rudis-Jicinsky, Cedar Rapids, Ia.: We should not have a one-sided discussion because we must use both the plate and the fluoroscope. It is just the same as to say that the static machine is no good; the coil is better. We heard that statement made years ago, but not now. The same is true of the plate

and the fluoroscope. We must use both in every case where they are indicated. We know that the fluoroscope has some advantages not possessed by the plate, and vice versa. For instance, we cannot photograph the position of the aneurism as easily as we can see it on the screen, and we can compare its position with the position of the heart. Of course, we can snap shot the heart in its position, but that is not so good and cannot be compared with the image we see on the screen.

In a case of pulmonary tuberculosis we know perfectly well that in no other way can we observe the movement of the diaphragm, the most important sign in tuberculosis, otherwise than with the screen.

The question was brought out this morning with regard to the peculiar appearance of the heart in tuberculosis. Rokitanski said that in pulmonary tuberculosis the heart is always small. Why? On account of the work it has to do. If that is the case, and it is, it is impossible to observe that small heart as well with the plate as with the screen. But I would not like to go on record as saying that the plate is worthless and that the fluoroscope is everything. Both these instruments are valuable and will be even more so in the future as they are improved. They will be better developed so that they will give better satisfaction than they do today, but they are so closely associated in this work that they cannot be separated.

Dr. Baetjer (closing the discussion): I am not advocating the use of the fluoroscope as a general thing. It should be limited entirely to the examination of the chest. My paper dealt with aneurism, and there the fluoroscope is more valuable than the plate. In my first sixty cases I used both the plate and the fluoroscope. Whereas the plate gave better detail, I found that I could study the movements of the heart and aorta and diaphragm better with the fluoroscope. In fact, with the plate you cannot study these movements at all. Thus, in this case of dilated aorta and diffuse aneurism, I fell down no matter how good the plate was. If the aorta were contracted, I got no shadow; if it were expanded, the shadow was visible. It was only by using the fluoroscope and seeing that the shadow did not disappear between pulsations that I could make a correct diagnosis.

The Regulation and Measurement of the Therapeutic Dose of the Roentgen Ray

BY ENNION G. WILLIAMS, M.D.,
Of Richmond, Va.

The Rœntgen Ray should no longer be looked upon as an empirical therapeutic agent or a magic light that acts by virtue of its august and mysterious presence. It is simply a newly discovered form of energy, governed by natural laws, regulated by artificial agencies and having a specific physiological action.

In regulating and measuring the therapeutic dosage all the factors concerned in the production of the ray as well as its physiological action must be taken into consideration.

Of the factors concerned in the production of the ray with each individual outfit some are fixed and some are variable. Among the fixed factors are the winding of the primary and secondary coils, the character of the interrupter, and the distance between the cathode and platinum disc of the tube. The variable factors are the currents supplied to the primary, the speed of the interrupter, the resistance in the secondary circuit, the degree of the vacuum of the tube, the distance of the tube from the surface to be exposed, the duration and frequency of the exposure.

Since it is the variable factors alone which are capable of regulation with each outfit these only will be considered.

The variable factors must be combined in the proper manner to bring about a desired result.

For our purpose in medicine and surgery the ray may be said to have three properties; first, a penetrative property; second, a property to affect photographic plates; and third, a property to affect living organic matter, which property might be called the

physiological efficiency. These three properties do not vary in the same proportion but are governed by different combinations of the factors. It is the first and chiefly the third with which we have to deal in therapeutics.

The penetrative property is in direct proportion to the resistance in the secondary circuit and this is regulated by the vacuum of the tube and the resistance due to the spark-gaps in series or the resistance regulator.

The third or the property to affect living tissues is to a certain extent in proportion to the energy given off from the tube. The intensity of the energy according to the law governing all forms of radiant energy varies inversely as the square of the distance. The physiological efficiency of the ray seems to depend more upon the degree of energy than upon the quantity of energy, and therefore cannot be in direct proportion to the energy. This is more apparent in the bactericidal influence; one strong intense exposure may destroy bacteria whereas a number of weaker exposures will not do so, although the total amount of energy may be the same. We see this exemplified in the treatment of lupus and other parasitic diseases. The principle is analogous to the coagulation of albumen by heat. Albumen only coagulates when heat is applied at a certain degree. It is the degree of heat and not the total quantity of heat applied that coagulates; or, to use another analogy, numerous small blows will not accomplish the result that one strong blow will, notwithstanding the fact that the total amount of energy may be the same.

The physiological efficiency or the influence of the ray upon the tissues is determined by experience and the microscopical study of the tissues exposed. The effect seems to vary from stimulation to complete abolishment of the vital principle and the changes incident thereto. The exact nature of the ray we do not know. Perhaps if we knew the forces that keep in motion the sub-atoms or animate a mass of protoplasm we would find the X-ray akin to them.

The action of the ray upon living tissues seems to be a dynamic one, that is, it influences the vital force but does not

influence the cells or tissues as do mechanical, chemical or other physical agents such as heat. There seems at first to be an increase of the vital principle then a cessation; or first stimulation then destruction. Since the cells are the elements wherein resides the vital principle which is influenced by the ray, we readily see that a tissue is affected in proportion as it has cells. Also the more vital principles the cells contain the more does the ray affect them. Since the vital principle is more active in cells nearer to the embryo we can now perhaps explain why the ray has a selective effect upon the spermatozoa and ova, and the cells of a malignant growth which are embryonal in character. Next in the order of their relative proportion of cells are the epithelial tissue of glands, hair follicles and the skin, and lastly connective tissues and muscles. The effect upon the last two tissues may be secondary due to the inflammatory processes initiated by the destruction of the cellular elements. The cells are deprived of their life, they now act as foreign bodies and disintegrate bringing about phagocytosis, infiltration of round cells and proliferation of the endothelium of the blood vessels and the consequent interference with the circulation which causes a degeneration of the muscles and connective tissue.

Although the physiological efficiency may not conform entirely to the law of varying inversely as the square of the distance it is the nearest guide we have at present to direct us in regulating the time and distance properly and in establishing a technic by means of which deep growths can best be affected without destroying the overlying tissues. As a rule the more superficial the effect desired the closer should the tube be placed to the surface.

It is very important that the operator should know the dose that will produce an erythema. It is only by this knowledge that he can intelligently treat any case.

By experience I have found that about ninety minutes is required to produce an erythema on the surface ten inches from a tube of medium penetration, a spark-gap of four inches equivalent to the resistance in the secondary circuit, and the milliammeter reading three-quarters of a milliampere.

With this knowledge and the law of the inverse squares, I have constructed a table* published in Medical News, N. Y.,

DISTANCE.	RELATIVE INTENSITY.			SAFETY LIMITS.
2 inches	1	1.000	25.00	2.5 minutes
4 "	1/4	.250	6.25	10.0 "
6 "	1/9	.111	2.77	22.5 "
8 "	1/16	.062	1.56	40.0 "
10 "	1/25	.040	1.00	62.5 "
12 "	1/36	.027	.69	90.0 "
14 "	1/49	.020	.51	122.5 "
16 "	1/64	.015	.39	160.0 "
18 "	1/81	.012	.30	202.5 "
20 "	1/100	.010	.25	250.0 "

March, 1904, to show the safety limits at various distances. The safety limits are about 30 per cent. less than the number of minutes required to produce a decided erythema. The table also shows the relative intensities at different distances so that if a number of exposures are given at different distances they can be reduced to the equivalent of a common distance and the total number of minutes then added.

We thus readily see how the law of the inverse squares helps us in regulating the duration of the exposures and the distance of the tube from the surface. Upon it is based the technic of attempting to reach deep growths.

The difficulty in reaching them has been the danger of injuring the superficial tissues before the deep growths are affected. Now we know it is not necessary to bring about a necrotic inflammation to destroy a cancer. If we can have the rays penetrate the tissues with moderate uniformity we can then hope to destroy the deep growths. The closer the part is to the tube the greater is the difference in the effect upon the skin and the part beneath. For instance, suppose we have a growth four inches from the surface and the surface four inches from the anode. According to our table the effect on the skin would be represented by .250 and that on the growth .062, or a difference of .188. Of course this does not take into consideration the loss of intensity due to penetrating the tissues. If the surface of the skin be placed at eight inches the growth will be at twelve; the relative effects will be .062 and .027, or a difference of .035. With the skin at

sixteen inches and the growth at twenty the relative effects are .015 and .010, with a difference of .005.

We thus see that the further the part from the tube the less is the difference between the effect on the skin and the part beneath. We should therefore place the part itself far off and make due compensation by increasing the duration of exposure directly as the square of the distance, or by referring to the table one can determine the duration for the exposure. My rule is not to expose in ten days more than the number of minutes required to produce a dermatitis. I usually give a treatment in series of four to six exposures each in which the sum total of minutes equals the number of minutes required to produce the desired effect.

The more accurately an operator can determine his dosage the fewer need be the number of exposures.

In regard to the regulation of the physiological efficiency by means of the other variable factors the most important of these are the interrupter and the current supplied to it. The secondary current is directly related to the number of interruptions and the current supplied to the interrupter.

Since, however, it is possible to have a current going through the primary and no current going through the secondary on account of a high degree of vacuum of the tube it is apparent that the primary and secondary currents are not in direct proportion. The product of the voltage and amperage of the primary should equal the product of the voltage and amperage of the secondary, but the winding of the coils and the resistance in the secondary determines the relative amperage and voltage of the secondary. Therefore the reading of the ammeter in the primary circuit will not be an accurate index to the current flowing in the secondary which at present is the best index to the energy given off from a tube and consequently the physiological efficiency of the X-ray.

Thus we see that the two factors directly and immediately concerned in the production of the radiant energy of the tube are the current flowing in the secondary circuit and the resistance in the secondary circuit due to the vacuum of the tube and the inserted spark-gaps. The current flowing in the secondary is measured by the Rœntgen milliammeter. The resistance in the sec-

ondary circuit is measured by the length of the spark-gap between the terminals on the coil and not the gap between the terminals of the regulating apparatus of the tube which is an index only to the resistance offered by the vacuum of the tube.

The spark-gap measures the resistance in the secondary circuit which gives to the ray the quality of penetrability; the milliammeter measures the flow of current which gives the energy to the ray and the two combined give the physiological efficiency.

There is an inverse relation between the resistance in the secondary circuit and the current flowing through it. The more the resistance the less the current and vice versa. Since we might say that the penetration is dependent upon the resistance and the radiant energy upon the current, the more the penetration the less the energy and the less the penetration the more the energy. This in confirmed by the milliammeter and by the fact that low vacuum tubes burn more readily or in other words have more physiological efficiency.

Now, to sum up: The physiological action of the ray is due to its influence upon the animating force called the vital principle and varies from slight stimulation to complete destruction. The vital principle resides in the cells of the tissues. A cell is affected in proportion to its vital principle. The vital principle is in proportion to the nearness of the cells to the original embryonal cell. A tissue is affected in proportion to the relative number of the cells it contains. The physiological action is dependent upon that property of the ray called the physiological efficiency. The physiological efficiency is the result of the combined radiant energy and the penetrability. It is therefore to a certain extent subject to the law of varying inversely as the square of the distance. This may not be wholly true because certain effects are at least dependent upon the degree of energy rather than the total quantity; on the other hand since the results of the ray do not reach the maximum effect until several days or weeks after the exposure the successive application is undoubtedly cumulative.

The penetrability is regulated by the resistance in the secondary circuit and is measured by its equivalent spark-gap. The radiant energy from the tube is governed by the current flowing through the secondary circuit and is measured by the milliam-

meter. Therefore to measure and record a dose of the X-ray there should be noted: The duration of the exposure, the distance of the surface from the platinum disc, the equivalent spark-gap and the reading of the milliammeter.

DISCUSSION.

DR. RUSSELL H. BOGGS, Pittsburgh: This is a very important subject, one to which I have given considerable time. Unless we do our work in a mathematical way, we cannot expect to produce results. I am sure that many do not observe the law closely enough that the light decreases inversely as the square of the distance.

In the treatment of certain skin diseases, you frequently see the tube placed at a distance when it should be close to the surface. By placing the tube at a distance, a ray is generated which acts more uniformal in the different layers of the tissue and is suitable for growths deeply situated. For skin diseases the tube should be placed close to the surface and the underlying tissues will not be injured. In the treatment of acne, for instance, if you place the tube at a distance from the surface to be treated, the subcutaneous tissues are affected and there is more or less wrinkling of the skin; while if the tube is placed close to the surface, the skin will remain smooth.

Dr. Williams pointed out that a tube placed at ten inches for ninety minutes, with three-fourths of a milliampere passing through the tube, is the dosage which produces a dermatitis. That is nearly correct. However, I believe that with different apparatus and interrupters this will vary. In order to produce a dermatitis with the tube placed at ten inches, exposure ninety minutes, with one of my coils, it would require at least one milliampere.

DR. KENNON DUNHAM, Cincinnati: The essayist has dealt with a subject in which every one who is working in radiotherapy is more than passingly interested. This is one of the vital points we must consider if we expect to accomplish anything.

Nevertheless it is not the paper itself which I wish to discuss, but a desire to call your attention to a little matter of interest in

connection with the paper; in reference to the X-ray being first mildly stimulating and then destructive.

Two years ago, at the Philadelphia meeting of this Society, I read a paper on the destruction of the lower organisms by the X-ray. Since then Dr. Geyer, Professor of Biology in the University of Cincinnati, said that in his experience it did not destroy the lower animals, but that it increased their activity. I asked him how he learned this. He said that he exposed some of these lower forms of life to radium and on subsequent examination found that they were more than ordinarily increased in number and activity.

In my article I called attention to the fact that future work would probably show that the very mild rays would produce the degree of activity which Dr. Geyer described, and I am very glad to be able to call the attention of the Society to Professor Geyer's work. He used a small piece of bromide of radium with only a moderate amount of activity. Thus I think that Dr. Geyer has proven the fact that the rays are at first active and we know that later they are destructive.

Dr. M. K. Kassabian, Philadelphia: I wish to call the attention of the society to one point, and that is the susceptibility of the patient. The action of the rays differs and the susceptibility of the patient also differs. Some patients can be exposed to the rays for months without causing a dermatitis, while other patients cannot be exposed for any length of time without being burned. Therefore, we cannot always regulate the dosage of the ray by any definite formula. We must gauge the dose for the individual case and not for the many.

In taking radiographs we often see that even when we use the same tube, the same apparatus and the same current the result is different; the penetration of the tissues and the effect on the plate differ. The penetration and the action of the rays depend on the vacuum of the tube and not on the amount of current going into the tube.

While abroad the past summer I saw Parisian physicians measure the dose of the X-rays by means of a paper known as Sabouraud and Noire pastiles.

This paper is placed on the surface of the body to be exposed to the rays and after a definite exposure the paper changes its color from pea green to tan, thus showing the maximum amount of X-rays to which the skin can be safely exposed. This is somewhat a modification of Holznecht's chromo-radiometer. This test paper is attached to the clinical record of the patient.

Professor Kienboch, of the Postgraduate Hospital, Vienna, uses bromide of silver paper, and Holznecht employs his chromo-radiometer. In Germany they do not pay so much attention to the dosage of the ray.

My method of measuring the dosage of the ray is to keep a certain tube for certain cases, keeping an accurate record of the length of the exposures and at the same time watching the patient very carefully, noting the action of the rays on the skin. If, after exposing for five to eight minutes three times a week for two weeks any untoward symptoms develop, I stop the treatment for two or three weeks.

Dr. Geo. C. Johnston, Pittsburg: I enjoyed Dr. Williams' paper very much. He is attempting to formulate a method of measuring an unknown radiation, and, I believe, he is on the track of the real Rœntgen unit. Although there is at the present time no unit of measurement, we will yet have such a unit; not this year or next year, but before many years have passed.

Attempts to measure the radiation from an excited Crooke's tube have been made in a variety of ways. The methods Dr. Kassabian mentioned all depend for their accuracy on the personal equation. The fact that certain fluorescent salts, such as barium platino cyanide and tungstate of calcium, change their color under radiation has been known for many years. The change in color is due to dehydration. If the water lost is restored to the substance, it regains its original color. They also undergo the change in color when subjected to radiant heat; therefore, if the tube is placed at such a distance from the surface of the patient and also from the observation screen that this portion of the screen is affected by the radiant heat from the tube, then you are measuring Rœntgen effect plus radiant heat, and, hence the measurement is inaccurate. These substances are also affected by other radiations besides the Rœntgen radiation.

Many more experiments are necessary before we can make use of these fluorescent substances to establish a Rœntgen unit. The placing of sensitized paper, placed in light proof envelopes, on the surface of the patient, and thus attempting to measure the degree of radiation received by the patient by the degree of radiation manifested on the sensitized paper, also depends upon the personal equation. These pieces of paper must be cut from the same sheet, they must all be equally sensitized; every piece must be developed the same number of hours after exposure, at the same temperature for the same time in a developer of the same specific gravity and containing the same chemicals. Those requirements manifestly prove that method of measurement ineffective.

The attempt to measure the radiation from an excited Crooke's tube by inserting in the tube circuit a meter is also beset by many fallacies. The meter indicates the load the tube is carrying, but it does not measure, as no meter made can, the efficiency of the tube as a transformer. Some tubes transform the electrical energy into greater proportions of radiant energy than others, yet these tubes will give the same milliammeter reading although the radiation will differ.

The resistance of the tube against the parallel gap also introduces the personal equation, and every radiographer knows that the amount of spark gap that a tube will back up is a very poor way of measuring anything about that tube. It is not a measure of the degree of vacuum of the tube but of the degree of resistance.

I hope that Dr. Williams will continue his work, and that he will be the man to discover the unit of Rœntgen radiation. I have never seen anything yet that is even a remote relative of a unit.

Dr. G. P. Girdwood, Montreal, Can.: I would like very much to have a unit; in fact, that is what we all want. Lately I have been seeing in my journals reference made to Benoit's test which tells you the amount of current you are using. I had one of the screens of which Dr. Kassabian spoke. I kept it in perfect order for two years. Then I loaned it to the hospital and in two days it was brown and it has never recovered its color, although it has been placed in all kinds of positions.

These indicators must be kept in a certain way, and that is a difficult matter with us in Canada, where the moisture in the atmosphere ranges from 90 per cent. of saturation down to nothing at all. It is in the winter that these screens all go to pieces, and they will do so unless they are kept just so. I keep mine in a tin box that closes pretty tightly and in which I place a moist cloth. That keeps the screen in good condition.

Holzknecht has another means of measuring. I have tried to find out what his laws mean, but I cannot get any idea what his unit is. I have tried to make a unit by using varying thicknesses of lead foil. Suppose you can read exactly to 1-2-3-4 Benoit, or any unit, you have the variation of the tube and the variation of the current going through it. I work very much with the same current, the street current or a motor current. In one second it is one current and in another second it is another current. What effect has this variation on the current going out of the coil? Those are mechanical difficulties about which we know very little. We must know all about them and the personal equation of the individual who is being treated before we can know what we are doing. I hope Dr. Williams will continue his excellent work, and that every one else engaged in the same research will continue his work until we have a unit.

Dr. Charles Lester Leonard, Philadelphia: I think the thing that we must also take into consideration is the equation of the tube as well as that of the patient and the operator before we can get a unit. In the tube itself lies a difficulty which requires much study before we can get a uniform method of measuring results.

Roentgen Ray Technic in Keloids

BY O. SHEPHERD BARNUM, M.D.,
of Los Angeles.

Since the successful light-ray treatment of keloids differs materially from that of the majority of skin lesions, I consider a clear picture of the condition necessary as preliminary to a discussion of technic in treatment.

In keloids we have a structure, in my opinion, unusually susceptible to the inhibitive properties of the Rœntgen Ray. Pathologically it is a fibrous new growth of the corium, more or less elevated above the skin, generally pink in color and firm to the touch. It is smooth and shining, and tortuous blood vessels can usually be discerned on its surface. The tumor is made up of bundles of connective tissue lying longitudinally with its longest diameter, nuclei and spindle cells being grouped about the blood vessels. At various points processes diverge which dip down into the surrounding skin, and in this way a considerable territory may eventually become affected in the same degenerative way. By the progress of these processes the overlying cuticle is sometimes drawn out over the adjacent healthy skin like a hood, thus forming pockets to the depth of half an inch or even more. The lymphatics are not involved.

The essence of the lesion is a debility and degradation of normal cellular processes—the displacement of highly organized corium by a non-vascular, white, fibrinous structure. In very rare instances it may progress to suppurative or even malignant degeneration.

It is a question whether there are any idopathic cases of keloid. I personally doubt if every case is not traumatic—the original trauma being so slight in many instances as to be entirely overlooked. Although we do find the disease apparently sequential to small-pox, eczema, and boils, yet the vast majority result from surgical operations, burns, scalds or flogging. The

negro race is especially susceptible to these growths. Pain is present in a large majority of cases, variously described as itching, burning, smarting, lancinating, and stinging.

Differential diagnosis is necessary from hypertrophied scar, but the distinction is not of very great importance to us in considering the therapy of the Rœntgen Ray in these lesions, since under the ray the results seem to be nearly identical. A rather extended experience leads me to say that the only difference manifest is a slightly greater stubbornness of a true keloid to answer to treatment.

It goes without saying that the length of time for successful treatment (together with slight modification of the same), are greatly influenced by the extent of the lesion. This fact in itself makes prognosis less favorable for quick results in keloid, since hypertrophied scar never encroaches on tissue beyond the line of surgical incision or suture-holes; while keloids may in time involve considerable surface, although the original was but a point. In one instance that came under my observation the total area affected amounted to eighty-four square inches on the back. Any part of the body may be attacked, but a majority of keloids are found over the sternum.

We have, therefore, to combat a retrogressive cell development, non-vascular compared with normal, fibrinous and, safe to say, without malignant tendency. Our object, in brief, is to inhibit the degenerative cell development, stimulate normal tissue processes and promote absorption. It is not only unnecessary, but unwise, to use the ray in these cases to the necrotic stage of the rayed part, and herein lies the difference between keloid and cancer under Rœntgen Ray. In superficial epithelioma, for instance, we seek to cause a complete destruction of the malignant cells and to promote sloughing. In this benign tumor we seek to stimulate normal cell development with its concomitant increase of lymphatic and venous circulation, thus leading to the absorption of abnormal tissue. Whether this process is aided by a fatty or granular degenerative change in the fibrinous keloid (a claim made by some pathologists), or whether the process is but analogous to the absorption of any simple infiltration of normal structure, I do not venture to say. The latter is a tenable

theory since we can well believe that atrophy, or cell inanition, follows the inhibitive action of the ray on the degraded tissue, and absorption naturally follows.

We all recognize the following factors in the equation of Rœntgen Ray therapy in each individual case:

Source of electrical energy.
Apparatus for exciting the tube.
Construction and vacuity of tube.
Abundance of the rays.
Time of exposure.
Distance of tube from lesion.
Idiosyncrasy of patient.

Of these the last can be almost entirely eliminated in treating keloids in the way I outline, since necrosis, or even dermatitis, is not necessary, and the tube is far enough away and the ray penetrating enough to prevent any serious superficial inflammatory changes. In some instances I have gone far enough to produce slight tanning of the healthy skin surrounding, but do not consider even that necessary.

As to the other factors. In general terms I advise a very great abundance of the rays from a tube of rather high resistance and excited by a large coil. I have no doubt we have all concluded that each and every one of the factors above enumerated should be as nearly as possible constant quantities, and this matter is worth great emphasis. I believe many reported failures in ray therapy are due to the faulty habit of the operator in changing exciting apparatus and tubes as the whim may dictate. Those two at least should be constant in any one case. Given a good coil, and a tube somewhere near suited to the individual case, and a proper adjustment of time and distance will accomplish all the variation necessary to successful use. I consider that the large variety of apparatus—coils, tubes, shields, and whatnot, such as my office affords, serves only to simplify and accelerate the work, and I venture to say almost equally good results could be obtained with but one sized coil and one tube, by proper adjustment of the same to each case.

To aid our discussion of technic let us take an hypothetical case, its prototype unfortunately too common.

Given a keloid on the sternum, say six inches long, one inch wide, one-half inch high, what are the essentials for treatment and what are the results?

1. Apparatus capable of generating abundant ray in tube.

Any tube properly excited will generate *abundant rays.* The truth of the remark we used to hear that "a coil will cause a burn much quicker than a static" was due to the abundance of the rays. Amperage seems to be necessary in the primary of the coil, the amount to properly excite a given tube depending on the size of the coil.

Three amperes will do as much in an eighteen inch coil as eight amperes in a twelve-inch coil. Abundant rays mean good penetration and good differentiation, and the tube should be closely watched and current increased as necessary to keep the proper steady glow. As the rheostat becomes heated during treatment its resistance increases and more current must be allowed to pass.

2. Rather a high tube, at least six inches in diameter. The terms high and low tubes are too ambiguous to be of much use to us in describing them. What I mean here by a rather high tube is one with considerable penetration which does not lack good definition. To differentiate between tubes a gradient of ray penetration must be used for comparison. I style the ray I use in keloid as a moderately *long ray,* i. e., one which will give me the bones of the hand at twelve feet distance, or the densest part of my gradient at four feet. It is better to have a tube too high than too low for this kind of work.

3. Distance fifteen to twenty inches from the lesion. The variation in distance from the tumor depends upon its thickness. The deeper the affected tissue the higher the tube, the greater the distance from the tumor, and the longer the exposure.

4. Exposure fifteen to twenty-five minutes on alternate days, for eight to ten treatments.

Then rest ten days, or until you are convinced that there will be no dermatitis, then repeat the process. Continue similar series until the tumor is quite disappeared—possibly three to six months—then make exposure for less time or less frequently until the last vestige of the lesion disappears and the desired cosmetic effects are secured.

I have three cases in mind illustrative of this method of procedure, briefly described as follows:

1. Keloid over sternum following excision of breast for sarcoma. It measured six inches long, one and a half inches wide, and about one-half inch high. Its growth was rapid and pain constant and severe. One hundred and twelve treatments were given, covering a period of sixteen months, with complete removal of the tumor and no return to date—a period of three years. In this case, as in all others, pain was eliminated almost at once, one result we may always expect.

2. Keloid over sternum of ambiguous origin, in measurement very similar to No. 1. This tumor had been removed by knife twice, returning in each instance in a few weeks in a much more active form. Ninety treatments were given with steady reduction of size and final cure in a few months.

3. Keloid involving entire right side of face following alcohol explosion. This was the worst case I ever treated and results were eminently successful. The process was somewhat slower than others, owing to more conservative treatment, but the redness quickly paled, tumors softened (they reached from the hair nearly to the clavicle), and absorption was apparent after thirty days' treatment. Eighty-seven rayings in all were made within a period of eighteen months, and at present, one year after cessation of rayings, there is normal color of skin and no signs of tumors whatever. Some lines of the old scar are visible when closely inspected, but at a little distance there is no difference noticeable in the two sides of the face.

My conclusion, based on successes like the above and with no failures, is that we are at liberty to prognose very favorably in treatment of hypertrophied scar and keloid by the Rœntgen Ray. Perhaps the entire matter of treatment might be summed up in the following general rules:

Select the most suitable apparatus available and stick to that.

At the slightest reaction on the healthy skin cease treatments until it fully subsides.

Do not ray too far.

Do not ray too fast.

Persevere.

DISCUSSION.

DR. H. K. PANCOAST, Philadelphia: I have treated several keloids, some with success and some with failure. The course of treatment in most cases must be a very prolonged one, and it has seemed to me that when possible, the duration may be greatly lessened by a preliminary partial or complete excision. This I have tried in one case, with success, and there has been no recurrence in two years. Another portion of this large growth has been treated by the X-ray alone for three years, and there still remains a trace of the tumor.

DR. RUSSELL H. BOGGS, Pittsburgh: I had a case that was similar to Dr. Pancoast's. It followed a vaccination. The tumor had been removed surgically twice and then the case was referred to me for Rœntgen Ray treatment. I treated it about three months. The growth gradually disappeared, although very slowly, and there has not been a recurrence in six months.

DR. ENNION G. WILLIAMS, Richmond, Va.: I agree with Dr. Barnum that it takes a long time to heal a keloid with the X-ray. I have had two such tumors to disappear, but it took several months.

I think it is better to excise first and treat with the X-ray afterward, and now I always advise that such a course be pursued. I have tried that in a number of cases, and thus far there has not been a recurrence of the tumor. In the two cases I referred to it was necessary to produce a most decided dermatitis before the growth disappeared.

DR. GEO. E. PFAHLER, Philadelphia: The doctor's paper was unusually interesting because he dealt with the subject systematically. I treated three cases of keloid all during the summer. Two of these cases got well; the third is still under treatment.

DR. G. P. GIRDWOOD, Montreal, Can.: I had a couple of cases that I treated during the last winter. One arose from a nitric acid burn on the chest over the sternum. From the very first day that I used the X-ray in this case the tumor began to

disappear. The patient has not been very regular in her attendance so that I do not know just what her condition is, but she tells me that she is almost well.

The other patient got the tumor following a cut with glass on the chest, and she also improved from the very first day. She had a great horror of the knife. She is now quite well. Whether there is going to be any recurrence in either of these cases I do not know.

DR. HICKEY: I would like to ask Dr. Williams how soon treatment was instituted in his case after operation.

DR. WILLIAMS: About a week afterward, as soon as they could remove the dressings.

DR. PANCOAST: My cases were treated in the same way.

DR. BARNUM (closing the discussion): With reference to operation being advisable in cases of keloid. I believe that there are cases where it would be permissible and possible, but there are cases that cannot be subjected to an operation because the tumor covers the greater part of the face. Nor is it necessary to operate as long as we can achieve the results we do with the X-ray. I have not had any colored patients, but in the twenty cases occurring in whites my results have always been good, especially in the case of the very large keloid which I mentioned in my paper.

Where the lesion is not extensive and where there is necessity for haste, I see no reason why we should not operate, the operation to be followed immediately by X-ray treatments.

In reference to the question of diagnosis in my cases. No treatment is begun in my office for any lesion without consultation with another doctor and the preparation of microscopical slides for verification. Slides are kept as part of the record in every case.

The Present Status of Radiotherapy

BY GORDON G. BURDICK, M.D.,
Of Chicago, Ill.

It seems to me that the time is ripe when Rœntgen operators should take some stand regarding the value of the Rœntgen Ray in therapeutics. It seems to be a fact that nearly all of the articles on radiotherapy appearing in medical journals are written by men who are not known in X-ray circles, and a great deal of harm has been accomplished in the general practitioner's mind at the present time, owing to the amount of misinformation that these men disseminate through the channels of medical thought. It is true, if workers in this line wish to save radiotherapy from its friends, to take a decided stand regarding the known value of the ray in disease. There is no longer any question of its value in many classes of skin disease, and it may be considered a specific in all forms of acne, lupus, eczema, psoriasis, pruritus, tinea, and sycosis, mycosis fungoides, senile keratosis, venereal condylomata, and hyperidrosis. Of this class of diseases noted, thousands of cases have been treated, and by different men, with unusual success. Therefore, it is time that the members of this Society let the profession know in no uncertain terms what we can do with a class of diseases with which they can do nothing. I respect conservatism in the medical profession as much as any man, but is it conservatism to tell a patient suffering from some disgusting skin lesion that it is considered incurable, and give him or her some ointment as a placebo, when there are hundreds of men in the profession who know that a sure treatment exists that will relieve these sufferers?

I have found a persistent attempt being made in some quarters to misrepresent the value of the X-ray, and it has been successful, owing to the fact that Rœntgen operators have been very reluctant to commit themselves upon any topic. It is admittedly hard to write upon this subject, as it is almost impossible to tell the whole truth about radiotherapy without dis-

crediting both the writer and the article in the medical mind. All operators have seen things happen in their laboratories that pass all of their former medical belief. It seems incredible to see a case, from fifteen to twenty years a sufferer from some disgusting skin lesion, with prescriptions in their pockets from many of the most eminent men in the profession, throughout the civilized world, traveling everywhere, consulting everyone, and being honestly told that their cases were incurable. How many of us have watched this same case, after being a few weeks under this mysterious radiation, slowly but surely make a complete recovery? If we have difficulty in crediting our senses, how much more incredible must it seem to the general practitioner who has not seen the transformation take place? For this reason I believe the time has come when some attempt should be made by all Rœntgen operators to educate the profession to the real value of the ray. There is a class of skin diseases that might be classed for radiotherapeutic purposes as "erratic"; in other words, some improve, some are cured, and some do not respond to the Rœntgen radiation in the slightest degree. Among the number that may be classed under this head are lupus erythematosus, pigmented and vascular nevi, hypertrichosis, and acne rosacea. Of this classification, the first two have offered the most difficulty, and while it seems that from a theoretical standpoint lupus erythematosus should respond to the X-ray, in practice it has been found that only about 18 per cent. are cured by the ray, while about 30 per cent. are improved, and the rest are not affected in the slightest degree, requiring other methods of treatment to bring about a favorable result, as the various modifications of the Finsen light, and the high frequency.

Pigmented and vascular nevi have improved under X-radiation to a marked degree, and in many cases have bleached out to such an extent that for all practical purposes a cure may be said to have taken place.

Hypertrichosis, or superfluous hair, has, on the whole, proved disappointing, as the use of the ray must be carried to the point of vesiculation in order to insure the complete disappearance of the hair. I have had a number of cases where a complete disappearance has taken place, but the treatment is fraught with so

much danger of scarring the face that under ordinary conditions it is not justified.

Epithelioma (rodent ulcer), when it exists in the skin alone, will yield favorably to X-radiation and leave better results than can be obtained in any other form of treatment. I now have over 80 cases that have been treated over three years, with no return of the disease or any metastatic trouble; where it involves the lip or the deep structures of the nose or the orbit, extreme difficulty is experienced with any method of treatment, and while a few get well readily, the great majority undergo a slow improvement but stop short of a full cure. With a lip epithelioma, or one on the penis, it is well to have the glands removed after a period of quiescence has been brought about by means of the ray. This method has been followed in 23 cases, and with success, as no recurrence has followed the operation for two years.

I want to impress upon you that the X-ray is sufficient in the great majority of these cases, and should invariably be used to the exclusion of the knife, except in such cases as appeal to the operator as favorably situated for a radical removal, without complicating the subsequent recovery by cicatricial bands and oedema from lack of drainage.

I have particularly noticed in my own practice that where the characteristic odor is present that, as a general rule, it will not be the most favorable case for X-ray treatment, or for that matter any other treatment. Where a case of this kind presents itself, I invariably anesthetize the surface, and by means of the galvanic current drive into the tissue for a prolonged time the zinc and mercury ions, causing an extensive slough to take place, and by following the separation of this necrotic tissue with the X-ray success is generally obtained.

I have noticed a peculiar condition of medical thought regarding this class of diseases among surgeons during the last year, a tendency to submit the patient to a partial operation, and depend upon the use of the X-ray to do the rest of the work. A case in point presented itself within the last month, of a physician who had an epithelioma of the penis, with a very contracted prepuce. After consulting various surgeons in different cities he was induced to submit to an operation by one of our eminent

brothers, who advised him that the X-ray would cure his penis, but would not affect the glands in the groin. He removed the glands, although Poupart's ligament and the surrounding tissues were undoubtedly infected, and it should have been evident to any observer that it was an anatomical impossibility to remove the infection, still the operation was done; and the strange feature consists in his refusal to circumcise the patient, under the theory that it would not heal up. He could see no danger in the lack of drainage under the prepuce, and the possibility of mixed infection taking place, leaving the patient in many times worse condition than he was before he operated. It might be of interest to state that he was circumcised by another physician, and that the wound healed promptly.

These cases should be classified in such a way that the general practitioner could be informed as to which cases should be sent for operation, and which class of cases should go to the X-ray operator. Where an operation is considered necessary, it should be as thorough as the surgeon can make it, and the use of the X-ray afterwards should be persistently carried on, in order to deprive any cancer cells of their power of reproduction.

As a general rule, post-operative radiotherapy has not always proven a success—owing to the shock and depression following the infliction of a serious wound; the body vitality is lowered, and the embryonic cells will grow long before the normal tissue is in a position to resist them. The drainage of the tissue is interfered with by the removal of the glands, and the formation of poorly nourished cicatricial tissue, and for this reason it responds to the destructive effect of the ray before the proper changes can be brought about.

It seems to me from the acknowledged success that the ray has obtained in this class of diseases that nearly all cases should be rayed before an operation is attempted. I have many cases of primary cancer that have undergone the retrograde process under the ray, until a complete disappearance has taken place, and I have decided for myself that hereafter nearly all cases will be treated in my own laboratory by this method, and an operation will rarely be considered.

In tuberculosis of the tissues, bones and joints, the X-ray has steadily won its way against the most determined opposition from the medical profession. It cannot be said, however, that the treatment is upon an established basis. At least two more years must elapse before this question can be settled to the satisfaction of the Rœntgen operators. We have all seen cases of this kind recover in our laboratories, and have been unable to offer a rational explanation of the phenomenon, but the idea is gaining ground that we have in the X-radiation the best and only known form of treatment that has successfully arrested the tubercular process, except rest, which always left a stiff joint. These facts should be made known to all Rœntgen operators, in order that they may be given a chance to carry on further experiments during the next year. There have been enough successes achieved to make this a "conservative treatment," and any operator who does not try the method in this class of diseases will not be doing justice to his patients. It should not be necessary, however, to caution all operators not to become so interested in treating the disease that they forget to treat the patient, as in many cases success can be obtained only by careful attention to minute details.

In pulmonary tuberculosis the ray has not given quite as good results as it promised to do in the beginning. All cases of primary and secondary tuberculosis are improved within certain limits, and in a certain per cent. of cases a prompt recovery takes place, but on the whole the great majority of cases fail to maintain their improvement in the way they should, and at the first unfavorable influence that surrounds them they immediately lose what they have gained, and a succession of these gains and losses takes place until eventually their strength fails them and they die, in spite of all that can be done.

There is a possibility that a modification of our technique might give us better results, as I have found that passing the rays through a grounded aluminum foil, in order to sift out the soft rays, and allow only the hard rays or the electro-magnetic pulse to pass, gives us a wonderfully stimulating effect. While by reversing the current through the tube for about one hour, in order to platinize the inner walls of it, we have a tube which

gives off soft rays alone, and they seem to stimulate granulations better than any other form of the X-ray. Unquestionably the same result could be brought about by sending the ray through a very thin layer of platinum foil, if it was possible to obtain some that was fine enough. Considerable experimental work has taught me that we have a new physical condition, one brought about every time the ray is passed through an element with a different atomic weight. The atomic weight and the thickness of the layer will bring about some very remarkable changes in the observed characteristics of the ray. Nearly every element is capable of transforming the ray to a new condition, and extensive observation should be made by many the coming year in order to further improve our technique, and perhaps we shall yet conquer tuberculosis by this means.

Tuberculosis of the peritoneum and prostate has yielded some most remarkable results, and should be tried in all cases of this character persistently.

Leukemia. We have an efficient means of relief, with a number of cases, in which apparent cures have taken place. It is marvelous to see a tumor filling the entire abdomen disappear steadily under X-radiation, see the process arrested by stopping the ray, and resuming its steady course as soon as the treatment is resumed; responding to the ray like mercury to heat. This terrible disease seems to rob the body of its recuperative power, and while the splenic tumor disappears and a general improvement in health takes place, generally death takes place within a year, from general debility.

There is a well-defined suspicion that the treatment should be carried over the entire body, as well as the spleen. This has been done in two cases, and a good result brought about. I have had eight cases of this disease, and had the satisfaction of seeing the splenic tumor disappear in each instance with a prompt recurrence in two cases, both of which yielded to further radiation, but eventually death claimed six of them, leaving the two cases, that have remained in a satisfactory condition for a period of one year.

Carcinoma. This disease will require at least one year's further investigation before any definite conclusions can be

drawn regarding its true place in radiotherapeutics. The principal difficulty seems to be a lack of confidence on the part of X-ray operators.

I have been fortunate during the last three years in getting 18 cases of primary carcinomata that offered every hope. All of these cases would not listen to the suggestion of an operation, and many of them would better be dead than have an operation, being young women with a fair future before them. All of these cases were treated actively with the X-ray; all of them are alive; in 14 cases the tumors and glands have completely disappeared; in 4 they did not disappear, but ceased growing. Two of them were submitted to the zinc and mercury cataphoretic process, in order to remove the tumor, because of its mental effect. All of these cases were of the better class of people, and the further developments of their cases are being watched with interest. From the success that has attended the use of the X-ray in post-operative and inoperable carcinomata, it seems that the time has come when X-ray operators should begin to treat the primary cases with the X-ray, excluding the use of the knife, or at least leaving it the duty of following up the treatment rather than preceding it. Physicians have looked upon surgery as a way to satisfy the minds of the patient's family that all was done that could be for their loved one. There is no reason why a treatment that has scored a great number of successes under the most unfavorable conditions should not be tried for at least one year, by all conscientious X-ray operators. It must have some specific action upon this class of cases, or results such as all of us have observed could not possibly take place, and we owe a duty to humanity to try and find out where the secret is hidden, and if we will observe the journals we will see that the surgeon is groping in the dark. We constantly hear of new operations and new methods of reaching this terrible disease, all calling for more radical surgery. One, a few weeks ago, was calling for the complete removal of the ribs upon the affected side. Every death after an operation we hear a "clarion call" *to send them in earlier,* always earlier, *never early enough!* It seems in the light of these facts that criticism of X-ray operators for treating cancer, should be disregarded and every case of cancer treated by the X-ray for a period of time that will completely settle this ques-

tion one way or the other. Any method of treatment where only one or two physicians can get results is open to considerable suspicion, and either the personal equation must be considered, or a general lack of knowledge of the subject is abroad, and requires closer association in order that private knowledge may become public property. No progress is made in any line of thought without someone experimenting, and in a disease where death is certain and inevitable, someone must experiment, or no cure will ever be found. Surgery has never pretended to be a cure. It has merely tried to cut off the disease from the body. Therefore, it is not in this line we should expect a desirable method; but unquestionably a cure exists. It remains only for some experimenter to find it. It may be in the physical field, in a chemical production, or, as most of us have hoped, in serum-therapy.

Sarcoma. It is in this disease that I have observed some of the most remarkable results that have ever been obtained by radiotherapy. In this disease we are badly handicapped by the fact that the general practitioner rarely is able to diagnose a case of sarcoma until sufficient time has elapsed to spread the disease all over the body, and as a usual thing some inefficient surgical measures have been attempted, and given up as soon as the character of the trouble was recognized. Most X-ray operators have been suffering from too much conscience, and have been content to give X-ray treatment after operation by the surgeon, and because the X-ray fails many times in post-operative sarcoma, they do not feel that confidence so necessary in the treatment of any disease. If they could only remember that surgery has been one prolonged experiment in malignant disease, extending over a period of fifteen years, which began by trying to remove the cancer from the patient, and has now progressed to the point where they are trying to remove the patient from the cancer, operations always more radical, and the results never satisfactory, it would be more easy for them to leave surgery out of the calculations and push treatment conscientiously; then something might be accomplished. I do not believe that any case of primary sarcoma exists that cannot be markedly benefited by a prolonged mild radiation from an old hard tube, well plated with aluminum, or from a new tube by passing the ray through a layer of aluminum, the thickness depending upon circumstances

in each individual case. But under no circumstances must irritation be produced. The persistent radiation gradually changes the character of the sarcoma cells and the tumor undergoes either a fatty or a colloid degeneration, and its characteristics will eventually disappear. One remarkable case of this character was a patient upon whom the late Professor Fenger had done a radical operation for a fibrosarcoma upon the leg. A recurrence took place promptly, and was immediately removed, but recurred in the wound, and also appeared in the ischium. Professor Fenger refused to operate, and suggested the X-ray. The young man began treatment with me, and kept it up for a period of one year, being treated on an average three times a week. The growth stopped within two weeks after the ray was used, and never made any further advance in the last five years. The tumors are still evident, but cause no inconvenience, and he works as a bacteriologist for one of the largest brewery companies in this city. He has had no pain, and if it was not for the stiffness of the muscles due to the extensive operation, he would not know that anything was the matter with him.

Another case of osteo-sarcoma of the shoulder, involving the humerus, scapula and clavicle, which was under treatment at the same time, is still alive, but not in as favorable a condition as the first case quoted. This patient was a physician, who developed a rapidly growing osteo-sarcoma of the shoulder, which attained the size of a man's head in the course of three months. He became alarmed and sought surgical advice, and no surgeon would dare operate, owing to the extensive infiltration, and they all told him that he could only live three months. He came to me in despair, and asked me what the prospects were for X-ray treatment. After a careful examination I told him frankly that I did not know, that it did not seem to me that anything could do him any good, but that I would give him the treatment if he would care to take it. He came in three times a week, from a town, 220 miles in Indiana, for treatment, and continued to do so for one year. When he began treatment his arm stood out from the shoulder at an angle of 30°, and he was unable to approach the body with it in any position. The pain was so intense that he could not exist without about three grains of morphine a day. The first result of the treatment was the stopping of the

pain. It changed from a steady to a paroxysmal character, and gradually ceased, except at certain changes of the weather. The tumor steadily shrank under the ray, until he could get his hand close to the body and put it to his mouth, and eventually, after six months, could use it to feed himself. He improved steadily in health, stopped the morphine, except during periods of great atmospheric disturbances; in the course of a year fluctuation was noticed, and upon incision about two quarts of colloid material discharged. He was now in good health, and remained so for two years, when more of the tumor broke down and discharged. No further growth of the tumor has taken place towards the body, although there seems to be a mild action further down the arm, which was protected during the treatment. He has begun to fail the last year, and gave up his business, and I believe that he will not live many months, owing to general ill health. The most careful examination has failed to show the growth of any metastasis in the body. The sarcoma has repeatedly broken down and has discharged immense quantities of colloid material, and this drainage has had much to do with his physical weakness. In this case, while a cure cannot be claimed, at least the growth that existed was checked so that he had at least four years in comfort, and that lease of life. He has been one of the most grateful patients I ever treated, and feels that the ray prolonged his life for at least four years.

I can recall a great many cases of primary inoperable sarcoma where the results have far exceeded that in this case; in many of these cases the tumor has completely disappeared, and the patients have remained in good health for five years.

Kidney Diseases. There are many indications that in the ray we shall find an exceedingly useful remedial agent. I have had two cases of Banker's Bright's disease that have recovered, while the patient was being rayed for an extensive patch of sycosis around the waist-band and psoriasis upon the back. The albumin disappeared completely in seven weeks, and remained away for three months, when the patients passed out of my knowledge. It was exceedingly gratifying to observe the improvement in the general health of the patients. It would be well if more experiments were made along these lines.

Fibroid Tumors. While raying a case for venereal condylomata, a large fibroid tumor was observed to decrease markedly in size, and further experiments should be made along these lines.

Gastritis. Several times while treating other diseases I have observed the disappearance of an obstinate gastritis. Further experience may show the ray to have some influence upon this trouble.

Tic Doloreaux. I have tried the ray in four cases of this disease, where it was of long-standing, and have been able to remove permanently the paroxysms in three cases. One of the cases was relieved temporarily several times, but persisted in recurring. The technique consisted of a short powerful exposure to the ray, once a week.

Epilepsy. A general improvement has been observed in several cases of this disease, while undergoing raying for acne and sycosis. In several cases the improvement was very marked, and amounted to practically a suppression of the attacks for several months, indicating a possibility that good results might be obtained with further study.

Elephantiasis. The effect of the ray upon this disease is remarkable. A steady retrogression takes place, and it is probable that a cure might be brought about if the treatment were persistently carried out. There are many other conditions which have responded favorably to the X-rays, but owing to the length of the paper I will not call attention to them, and devote a few words to the general technique involved.

I have endeavored in all cases to regulate the penetration to the exact depth that I desired work to be done.

Second, have selected rays, that are either hard or soft, for use in suitable cases.

The hard rays are obtained from an old tube, well plated with aluminum, or by passing the ray through a grounded screen of this metal.

Soft rays may be obtained from a new tube, low in vacuum, or from an old tube, by reversing the current through it for fifteen to thirty minutes, in order to platinize the inner walls of the tube, or by passing the ray through a grounded layer of same metal; a dense atomic weight, such as lead or platinum foil of approxi-

mately 1/10,000 of an inch in thickness, will sift out all of the hard rays and leave the soft.

The hard rays are used where a stimulating action is required, as in ulcers and many deep-seated diseases. They will rarely cause any irritation of the skin.

The soft rays are used to destroy infection; are exceedingly active from a chemical standpoint, and may be sent through the body by regulating the electro-motive force of the apparatus. I have found by extensive experimenting that the resulting wave of the ray is modified by its passing through metal of all kinds. The atomic weight of the metal and its thickness determine the resulting length of the wave. I have found further that the cells respond in a different manner to the slightest change in the period in which the ray is sent out into space.

I wish to appeal to all physicians who are using the X-ray in therapeutics to be X-ray operators, for a period of one year, in order that we may know by the next meeting the exact value of the ray in disease. I don't mean by this that other means should not be used, but that cases should be treated persistently that are primary in character.

DISCUSSION.

Dr. Arthur Holding, Albany, N. Y.: I would like to ask Dr. Burdick to tell us what his diagnosis in these 18 cases of primary carcinoma of the breast was based on. If I understood him correctly they occurred in young women.

Dr. Henry E. Waite, New York: I was particularly interested in what Dr. Burdick said about the use of diaphragms and the medication that he carried into the tissues. We know that the density of metals cuts out certain rays and investigations along that line are of great advantage to us.

Dr. P. S. Moncure, Norfolk, Va.: I would like to ask Dr. Burdick whether the specialist gave him the credit of benefiting his case or whether he gave that credit to himself. If it can be proven that these cases of Bright's disease can be benefited by X-ray treatment, it opens up to us a new avenue of work.

Dr. J. C. Price, Scranton, Pa.: I would like to report what at the time seemed to me a rather unique experience. A

woman came to me with a supposed carcinoma of the breast. On examination I found that she also had acute Bright's disease, and I learned that she had been given only a few months to live. I rayed the breast tumor carefully, the tube distance being about twelve inches, three times a week, with intervals, for nine months. At the end of that time her kidney condition was very much improved. That was four years ago. The woman is still living, but, I understand, she has her kidney trouble yet.

DR. PARK P. BRENEMAN, Lancaster, Pa.: I would like to know a little more about the treatment of carcinoma of the breast. I have treated many of these cases, both primary and secondary, and they have improved markedly for awhile. One or two were apparently cured. I have treated thirty or forty cases in the last four or five years, but they are all dead now.

DR. KENNON DUNHAM, Cincinnati, O.: It is very nice to report cures of carcinoma and sarcoma, but we must not lose sight of the fact that such claims must be based on a positive diagnosis of the tumor. We must not attempt to treat a case unless we know just what is the matter with the patient. The case should be gone over very carefully and thoroughly and a complete diagnosis established before the treatment is begun. It is wrong to claim to have cured a case of carcinoma when the diagnosis was not confirmed microscopically. In other words, we may treat a case without making section of the tumor where such radical measures are not for the good of the patient; but then we may not report that case.

DR. CLARENCE E. SKINNER, New Haven, Conn.: I would like to ask Dr. Burdick to describe this technic in treating that case of osteo-sarcoma of the shoulder.

DR. HENRY H. COOK, Detroit, Mich.: Dr. Burdick spoke of the possibility of treating these cases without operation, and in one class of cases this was brought out more than in the others, and those were the cases of carcinoma of the breast. It has been my experience that better results can be obtained in these cases by raying first, then operating, and then raying again, or, if this is not possible, to operate and follow immediately with a course of X-ray treatment. In sarcoma I have obtained better results in the cases that were not operated on.

The doctor also mentioned a case of diabetes. It was my ill fortune to have a case of beginning diabetic gangrene, and from all the reports I could collect, it seemed to me that the case was hopeless. There was an abscess on the upper lip that showed absolutely no tendency to heal. The surgeon who had been treating the case turned it over to me for X-ray treatment. In three weeks there was a most decided improvement, and the case has since cleared up, and has remained so since last fall.

Another remarkable feature in the case was that the patient complained of intense headache which had been almost continuous for months. That has also disappeared entirely.

In some of the chronic skin cases the results obtained are probably often due to the mild stimulation. I had a case of severe burn in which there was also present an infection caused by a yeast fungus. The patient was employed in a brewery. He fell against a steam pipe and burned a large area at the elbow. It refused to heal and I was at a loss to account for it. I studied the case carefully and finally concluded that it was a yeast infection. Under continued X-ray treatment the case cleared up entirely. We had just healed that arm when the man fell again against a steam pipe and was burned on the opposite shoulder. This was treated at once and it cleared up nicely. There was no scar following the burn.

Dr. Burdick, closing the discussion: I fear that you have misunderstood me. I am not fighting the surgeon. The X-ray operator should possess individuality instead of merely doing what others tell him to do and taking the responsibility of all cases the surgeon may unload on him. The surgeon has done much good, but the statistics which he publishes are not always reliable, even those coming from the best hospitals in the country.

As far as the diagnosis of the cases mentioned by Dr. Holding is concerned, I will say that in many of them a microscopic diagnosis was not made. All these cases were seen in consultation with some of the best surgical talent and the diagnosis was so positive that every one of the surgeons wanted to remove the breast. The patients would not consent to an operation, nor would they allow us to take out a piece for microscopic examination.

From the surgeon's standpoint, if a case gets well under X-ray treatment, it is not cancer; if it does not get well, it is cancer.

The case of Bright's disease I mentioned was an accident. I merely suggested it to you in order that any of you who have many of these cases can carry on further investigations along that line. I suppose all of us have seen cases get well and then drop off with apoplexy or something that we cannot account for. I have had a number of cases that practically recovered and then died under the knife. A case that has been rayed for any length of time does not make good surgical material, especially if the radiation has been quite general.

I did not have an opportunity to read the technic I employed in the treatment of these cases. That portion of my paper which I did not read treats of the technic and you will have an opportunity of reading it when the paper is published.

Ante- and Post-Operative Treatment of Cancer of the Breast

BY GEORGE C. JOHNSTON, M.D.,
Of Pittsburg, Pa.

The findings of various pathologists agree closely upon the changes taking place in carcinomatous tissue when exposed to therapeutic doses of Rœntgen Ray, and by the interpretation of their reports, good and sufficient reasons for ante and post operative radiations are afforded.

These changes consist of a breaking down of the islands of carcinomatous cells, beginning and most pronounced in the rapidly growing periphery. The neuclei are broken up, the celi walls broken or ill defined. A peculiar endarteritis of an obliterating type has attacked the blood vessels and the vessels are surrounded by masses of small cells. This degeneration is apparent even in the deepest portion of the tumor.

Later sections show a replacement of the carcinomatous masses by simple connective tissue. This degeneration is not a result in all probability of the endarteritis since it is often observed before the endarteritis is manifested. It is more likely the result of the response of the individual cells to the peculiar irritation caused by the ray itself.

The response of the cells to the irritation is first a stimulation of activity, then overstimulation followed by destruction. The cells are affected in the order of their physiologic activity, and specialization. Were the cause to act for a sufficient time with a sufficient intensity, even the normal tissues would suffer, but in carcinoma it is happily the ingrowing epithelial nests with their rapid proliferation and heightened activity that suffer first. A differentiation is thus made possible.

A dosage can be formulated and administered potent enough to destroy the pathological tissue, yet sparing the normal. Moreover, by the continued application, the resulting endarteritis cuts

down the blood supply upon which the anarchistic career of any neoplasm is directly dependent.

In addition to this well defined change in the tumor, and the blood vessels, there is found a peculiar action manifested upon the lymphatics, both vessels and glands.

The vessels are, so to speak, sclerosed. The glands themselves are small, hard, fibroid masses bearing but little resemblance to glandular tissue. This condition is shown not only in carcinomatous glandular involvement, which has been subjected to Rœntgen Ray, but also in tubercular adenitis.

It, therefore, appears that in a case of carcinoma of the breast, the application of the Rœntgen Ray of sufficient intensity, for sufficient time, is capable of causing a disappearance of the tumor and disappearance of the carcinomatous cell nests, their replacement by normal connective tissue, a proliferative obliterative endarteritis, and a sclerosis of the lymphatics, vessels and glands, leading from the affected part.

If this be true and a multitude of observers concur in their findings, we possess in this radiation, an agent which fulfills every indication to be desired in the treatment of this disease, if there were no other factors to be considered, yet in truth the use of the ray alone in the treatment of carcinoma is justified in but few cases and the main stay remains as of old in careful complete surgical extirpation in operable cases.

Since the experience of years has demonstrated, however, that operation alone, even in apparently favorable cases, is not followed by a percentage of successful results that can be complacently reviewed, it seems to me good surgery and good sense to combine with operation, an agent which has demonstrated for itself a directly selective, destructive affinity for carcinoma wherever situated.

It is admitted that carcinoma spreads through the lymphatics. When metastasis occurs this is the path through which the infection, so to speak, has traveled. It has been observed by not a few men, that some cases show a metastasis so quickly following operation where the lymphatic system has been considerably disturbed, as to give rise to a suspicion of cause and effect.

It seems to be plausible that in an operation for carcinoma, with extensive dissection and large wound surface, with thou-

sands of gaping lymphatics covered during the manipulation necessary with carcinomatous debris, it is quite possible that infection should occur under such conditions. If before the operation these lymphatics and glands had been practically obliterated by a course of ante operative radiation, this dangerous contingency should be avoided. Moreover, since it has been proven that such radiation has the power of directly influencing the vitality of the cells in the order of their physiologic activity, such carcinomatous material as might find its way into the open lymphatics might be assumed to be of a lower vitality and less dangerous, therefore, than it would have been had the ante operative radiation been omitted.

The objection to the ante operative radiation that has been advanced by many surgeons, is that it interferes directly with the healing of the operative wound which sometimes shows a tendency to become gangrenous. This is only the case when a decided overdose, sufficient to markedly impair the vitality of the tissues forming the flaps has been administered. Such an amount of radiation is neither desirable nor necessary, since the effect upon the carcinomatous tissue and the lymphatic system should be manifested long before the vitality of the healthy tissue is impaired.

A course of radiation not to exceed 10 treatments of 20 minutes each, at a tube distance of 18 inches, is sufficient in the majority of cases to accomplish the desired prophylactic result. A tube of fairly low vacuum should be employed carrying a current not to exceed 2½ milliamperes. This should not be followed by any considerable degree of dermatitis, and in my experience, the healing of the wound is all that could be desired. Following the operation on about the 15th day, a series of post operative radiations should be begun. The reason for this is evident, since an operator no matter how skilled and experienced he may be, can never be certain, that in his operation he has succeeded in removing every vestige of carcinomatous tissue, every infected lymphatic gland and trunk. Unless this has been successfully and completely accomplished, recurrence must be expected. Since this happy result is very seldom obtained, and since we have in the X-ray an agent capable of determining exactly between healthy and carcinomatous tissue, and also capable of de-

stroying such affected tissue, while yet sparing the surrounding healthy tissue, what good reason is there to advance against the routine employment of this agent as a prophylactic against recurrence in conjunction with operation for carcinoma wherever and however situated?

The ideal of surgery is asepsis, yet many good surgeons prefer the use of a little astisepsis in addition. The aim of surgery in operations for carcinoma is to remove the disease in its entirety, but I believe a little Rœntgen Ray "antisepsis" against recurrence is advisable as well.

Post operative radiation properly applied can do no harm. Improperly applied, it can do harm by interfering with the healing of the parts and might even produce a dangerous dermatitis, but it is not to be decried on this account. Just so might an intravenous injection of bichloride solution be administered to an exsanguinated patient by a careless nurse, in place of a normal salt solution, but the bichloride will not be barred from the operating room even though this may happen; the nurse, however, should be promptly barred from the room forever; so in case post operative radiation produces unpleasant results, the best remedy is to procure an operator possessing sufficient judgment and experience to justify a surgeon in entrusting this most important part of the treatment to his hands. Nurses, orderlies, engineers, and resident physicians are usually much more competent to operate on these cases than to ray them, although the former proceeding would not be tolerated for a moment.

I believe that a careful investigation of this practice and its adoption as a routine measure following operation for malignancy in the breast will result in a remarkable change in the statistics of this disease. Moreover, a familiarity on the part of the surgeon with the actual power of this agent in controlling carcinoma will result in a change in the classification of these cases; we will hear less of "inoperable" carcinomas of the breast.

Many cases that are now looked upon as hopeless, and in which surgical interference is considered unjustifiable, will be submitted to surgical means with a fair expectation of permanent relief. Under the method mentioned above, cases of extensive carcinoma may be taken in charge, rayed, operated, and by a continuous post operative treatment freed from carcinoma.

To do such work successfully requires the hearty intelligent co-operation of the surgeon and the radiologist. Working together with a full knowledge of the limitations of their art much can be accomplished. In such cases two important factors must be constantly born in mind; first, the X-ray must not break down more tissue than the patient can successfully and safely eliminate. Second, the knife must not remove more tissue than is absolutely necessary. No attempt need be made to perform extirpation of all infected tissue since, if the case be inoperable, under ordinary circumstances this would be impossible. The operator should aim at removing as large a quantity of carcinoma as is consistent with safety to the patient, yet hemorrhage and shock must be carefully avoided, since the patient will require strength and blood to carry her through post operative treatments.

Large plethoric fat patients, even with enormous carcinomas and extensive operations, do better than smaller, thin and anaemic patients. They have more resistance and the progress of the disease is usually slower. By this method then, it is possible to bring within the range of hope, a class of cases which under ordinary methods of treatment are among the most pitiable with which the surgeon has to deal. A large percentage of successful results need not be expected and will not be obtained, but failure should only stimulate repeated endeavors. The salvation of one ordinarily hopeless case is a greater victory than a long series of successful results in ordinary primary cases.

That class of operators who are easily discouraged by failures, who in other walks of life would be known as "quitters," are not advised to undertake the treatment of this class of cases, but those men to whom a single success is a constant spur and repeated failure but an incentive to renewed endeavor, can undertake this work with a fair expectancy of success.

I will report in this connection a single case illustrating the technic employed, and the class of cases described.

Miss A: Referred by Dr. Stevenson, of Pittsburg. Aged 60. Weight 185. Large carcinoma of the breast with axillary and supra-clavicular glands involved. Carcinomatous nodules above the clavicle and studded over the other breast along the sternum and posteriorly over the scapulae. Halstead operation

by Dr. Langfitt, after a preliminary series of ante operative radiations extending over two weeks. So much tissue was involved and removed that no attempt was made to approximate the edges of the wound, but an area of 6x8 inches, exposing the chest wall was left uncovered by flaps. On the 15th day following the operation which was accomplished with but little hemorrhage and shock, radiation was begun, exposures being made directly over the wound through the dressings, under the arm and to the back. The length of exposure was 10 minutes in each location, 30 minutes in all, treatment being given every other day. Granulations began promptly and in two months the large open wound had entirely closed.

A few small carcinomatous nodules appeared *during treatment* over the front and back of the chest, but upon being sufficiently attacked disappeared. Recovery was uneventful, and the patient remains in perfect health at the present writing, almost two years having elapsed. This case was inoperable from a surgical standpoint and from the extent of the metastasis might have been considered hopeless, yet she remains to-day in perfect health.

An attempt to treat such a case without surgical assistance would have simply resulted in overwhelming the patient with the broken down carcinoma and an auto intoxication would have caused her death.

It is the hope of the writer that this short paper may bring out a discussion of this subject which will result in a better understanding and a different viewpoint of this question for both the surgeon and the radiologist. I believe that the best interests of a most unfortunate class, the sufferers from cancer of the breast, demand a careful investigation of the truth or fallacy of the statements expressed, which represent the belief of the writer founded upon a study of this method during the past four years.

DISCUSSION.

Dr. J. Rudis-Jicinsky, Cedar Rapids, Ia.: I always use the knife in individual cases, and I ray both before and after operation. The results I get in that way are far superior to those I get when I use the ray alone.

DR. H. K. PANCOAST, Philadelphia: It seems to me that Dr. Johnston has "hit the nail on the head" in regard to the treatment of carcinoma of the breast. The most conservative men must agree with him that perfect asepsis is absolutely necessary in treating these cases. I think a pre-operative course of treatment is preferable in all cases in which it is possible, but I am convinced that many surgeons still regard the X-ray treatment of deep-seated carcinoma in the experimental stage. They are not ready to admit, in the first place, that X-ray treatment should be given before operation, as they still feel that it is theoretical to assert, for example, that the lymphatics will be blocked up by preliminary X-ray treatment, and they also feel that such a procedure would interfere with the healing process afterward. This is the feeling among surgeons, but not among X-ray specialists.

The immediate post operative treatment offers the only chance for the patient if metastasis has occurred, but I do not believe that many cases of carcinoma of the breast can recover if there is a decided metastasis in the mediastinum. All my cases that died have been just such ones. Possibly, if the metastasis has just started, with the glands but slightly enlarged, the X-ray may remove the carcinomatous tissue, but if once the disease has gained a good foothold, the patient has very little chance of recovery. That is one of the reasons for operative treatment in addition to X-ray treatment, but the operation should be performed early.

DR. GEO. E. PFAHLER, Philadelphia: I would like to ask Dr. Johnston to tell how long, in his opinion, a case ought to be treated before operation and how long it should be treated after operation. These are the questions surgeons ask us and we must be prepared to answer them. We should be able to formulate, in a general way at least, an answer as to how many treatments should be given before and after operation.

As to the treatment of the carcinomatous nodules after they reach the mediastinum. I would like to refer briefly to six cases of that character. Three of these cases are to all appearances well to-day, and there was not the slightest doubt about the diagnosis. The carcinomatous masses in the chest could be de-

termined by physical signs, by symptoms and by radiography. So that we need not throw up our hands even when the disease has extended to the mediastinum, although the chance of recovery is lessened, but even at this late stage we should hope for some results.

DR. JOHNSTON, closing the discussion: I thoroughly agree with Dr. Pancoast that in those cases in which there is mediastinal involvement we are extremely lucky if the patient lives after the best X-ray man and the best surgeon have given the patient the best treatment. I am unable to tell when there is mediastinal involvement; therefore I always hope that my patient has not got it and treat her as though she had.

I believe that the Halstead operation would give us at least ninety per cent. of cures in primary carcinoma of the breast if it were not for the mediastinal involvement. The point has been raised that the pre-operative treatment is simply delaying the operation. I do not think that I ever saw a case of carcinoma of the breast where the operation could not be delayed safely for a week or ten days. As a rule the patient has been delaying the operation for a year or more before she comes to see the physician.

The most important thing in this whole connection is to get a thoroughly tractable surgeon and be of all the assistance to him that you can, your results will be much better than they would be otherwise. Do not tell the surgeon what to do, show him. Just as soon as he finds out that by working in conjunction with you he will get much better results, that he can treat successfully a class of cases that he has feared to treat before, you will not have any more trouble trying to get that man to do just what you want him to do.

In regard to the number of treatments it is necessary to give before the operation, I have treated them as long as three weeks before, but usually we must do the best we can, and if you get them as late as ten days before, ray, because you have done something anyway that is of value in the treatment of these cases. After the operation I like to ray the case for about three

months and then keep them under observation for a year, keeping in close touch with the surgeon all the time. Simply discharge these cases on probation. I have not cured a single case of anything, but I have a lot of cases that are apparently cured that I have discharged on suspicion. I want to see them from time to time. We must wait at least ten years before we can call an apparent cure of carcinoma of the breast, an actual cure.

Late Results of the X-Ray Treatment of Sarcoma

BY WILLIAM B. COLEY, M.D.,
Of New York.

Mr. President and Gentlemen.—Inasmuch as I have only very recently, in a paper read before the New York Surgical Society, reported the final results of our work at the General Memorial Hospital with the X-ray in malignant tumors, including sarcoma, you will pardon me if some of the things I shall say to-day are a repetition of that paper. (Annals of Surgery, August, 1905.)

I have been deeply interested in the subject of sarcoma for many years and when the X-ray began to be used for malignant disease, about four years ago, I had an exceptional opportunity to try the method upon sarcoma. The results of this trial extending over a period of nearly four years, as well as the results of the method in the hands of other men, I shall endeavor to very briefly set before you:

During the past 3½ years we have observed 68 cases of sarcoma treated by means of the X-ray. In 17 the head and face were the seat of the disease; in 13 the neck and shoulder; in 10 the lower extremities; in two the upper extremities. The chest wall and pectoral region in 4; the back in 4; the abdomen in 6; the testes in 5; the ovaries in 3; four occurred in other parts of the body. A few of these cases were treated by myself personally; the majority, however, were treated at the General Memorial Hospital by Mr. W. P. Agnew and Dr. James Oglevie, under my direction. These cases represent practically every type of sarcoma. In six of the 68 cases complete disappearance was observed, but in every one of them there was a recurrence within a few months from the time of the disappearance of the disease. In two of these cases the recurrent growths subsequently disappeared when the injections of the mixed toxins

of erysipelas and bacillus prodigiosus were added to the X-ray treatment. These two cases are still well at present, one nearly three years, the other one year after the disappearance of the last recurrent growth. They are of sufficient importance to merit a brief description:

Case 1. Small Round-celled Sarcoma of the Back. W. J., aged 11 years. Family history good. Toward the end of August, 1901, the patient fell from a stoop, striking on his back. Two or three weeks later a soft fluctuating swelling appeared in the midscapular region and increased rapidly in size. The patient was referred to me in December, 1901, by Dr. Polhemus, of Nyack, N. Y. Physical examination at that time showed a cystic swelling the size of an orange in the left scapular region, situated apparently just beneath the skin and superficial fascia. On January 12, 1902, an incision was made under ether and several ounces of dark blood evacuated. The wound closed without drainage by primary union. About three weeks later a tumor began to develop at the site of the former swelling. This grew rapidly, and when I operated again in May, I found in addition to blood clots a very suspicious thickening of the walls of the cyst. Microscopical examination of the thickened tissue made by Dr. H. T. Brooks, of the Post-Graduate Hospital, proved it round-celled sarcoma of high vascularity. The X-ray treatment was begun two weeks after operation, before the wound had entirely healed, and was kept up steadily. Despite the treatment a local recurrence set in in December, 1902. This increased in size, so that in January, I felt called upon to operate for the third time. I removed the recurrent tumor together with the old cicatrix. Although the X-ray treatments were promptly resumed and continued regularly once or twice a week, signs of another recurrence became apparent in June, 1904. In addition to the X-ray I then began the local injections of the mixed toxins of erysipelas and bacillus prodigiosus two or three times a week, with the result that the recurrent growth slowly disappeared, the ulcerated area healed over and by the end of June, 1905, there being no trace of a growth anywhere discernible, the treatment was discontinued. The boy is at present in perfect health.

Case 2. Round-celled Sarcoma of the Femur Involving the Lower Two-thirds of the Shaft. A. G., 19 years of age. First

noticed a swelling in the lower portion of the femur in November, 1901. This increased in size and at the time of my first examination, February 5, 1902, extended from the condyles of the left femur to the junction of the middle and upper third. There was a fusiform enlargement of the entire lower two-thirds of the femur and slight impairment of the functions of the joint itself. An incision was made under ether into the swelling and two or three ounces of clear serum were withdrawn. A curette was passed into the cavity of the bone and typically sarcomatous tissue removed, which, on microscopical examination by Dr. E. K. Dunham, proved to be round-celled sarcoma. Amputation at the hip was advised but absolutely refused. The X-ray treatment was begun entirely as an experiment. At the end of four weeks the circumference of the tumor had decreased an inch. Upon discontinuing the treatment for two weeks the tumor again increased to nearly its former size. The X-rays were resumed and by the end of December, 1902, the measurements of both legs were equal, although there was still some thickening in the lower part of the femur. The old sinus which had never healed after the exploratory incision, was enlarged under ether and carefully curetted. Examination of the tissues failed to show any trace of sarcoma. The patient had gained 20 pounds in weight. Nevertheless, toward the end of December, 1902, a metastatic tumor, very soft and vascular, began to develop in the pectoral region; it grew rapidly and when it had reached the size of a hand, was removed. A little later a tumor the size of a child's head developed in the right iliac fossa extending from the costal cartilages down to the pelvis. In addition to the local treatments with the X-ray in the femur and pectoral regions I then began the use of the mixed toxins of erysipelas and bacillus prodigiosus. A few weeks later the large tumor in the iliolumbar region began to soften and break down and on becoming completely fluctuating was opened posteriorly. A large amount of necrotic tumor tissue was evacuated and the sinus drained for about a year. At the present time, nearly 2½ years later, the boy is apparently in perfect health, except that the sinus in the leg and the thickening of the bone have persisted. There is absolutely no evidence of sarcoma to be found.

Two of the remaining four cases in which the tumor completely disappeared, have since died, one of internal, the other of general metastases; in the third a fatal issue is expected at any moment. The fourth is still living with a recurrence that has not yielded to the combined X-ray and toxin treatment, although there has been improvement.

A brief resumé of the histories of these cases may be of interest:

Case 3. Extensive Recurrent Round-celled Sarcoma of the Neck, Both Sides, Superior and Infraclavicular, Pectoral and Axillary Regions on One Side, and Mediastinal Glands. The patient, M. A., 45 years of age, was in such a hopeless condition that she was not expected to live more than two months. The mixed toxins had been used with improvement at first, but later ceased to have any influence upon the disease. In February, 1902, I began the X-ray treatment purely as an experiment, but the improvement was most striking and rapid. Within a few months the tumors had completely disappeared, the last nodule having been removed under ether for pathological examination which confirmed the original diagnosis. The patient regained her normal strength and spent the summer in the country. When she returned by the end of September, there was local as well as metastatic recurrence. These recurrent growths again yielded to the X-ray treatment, which was promptly resumed, but the improvement was not permanent. The patient remained under X-ray treatment and was in fairly good health up to the early part of 1904, when her general health became deteriorated and she died in January, 1904, or about three years after she had been given up to die.

Case 4. Small Round-celled Sarcoma of the Pectoral Region. E. M., aged 35 years; had been twice operated upon for sarcoma of the right pectoral region by Dr. Maurice H. Richardson, of Boston, and a microscopic examination made by Dr. W. F. Whitney at the Massachusetts General Hospital proved the growth to be round-celled sarcoma. The last operation was performed in October, 1901. The disease then involved the pectoral and axillary regions so widely that it was impossible to make a complete removal. The patient was referred to me by Dr. Richardson in October, 1901. Under the treatment

with mixed toxins the tumor softened and in January, 1902, a spontaneous opening occurred with evacuation of about a pint of necrosed tissue. In February, 1902, the X-rays were added to the toxins, causing continued decrease in the size of the tumor. In June, 1902, the growth had entirely disappeared and the patient had gained 20 lbs. in weight. In January, 1903, a small movable nodule in the pectoral region was discovered. This disappeared under six weeks' treatment with the mixed toxins and X-rays. In December, 1903, he had another slight local recurrence, which again yielded to the combined X-ray and toxin treatment. The patient remained well until the early part of 1904, when he had a local return which never entirely disappeared, although he remained in good general health up to the end of May, 1905. Physical examination on July 5th, 1905, showed an extensive local recurrence and evidence of extension of the disease into the lung and pleura. He was much emaciated and died September 17, 1905.

Case 5. Inoperable Round-celled Sarcoma of the Chest Wall Involving Ribs, Treated by the X-Rays Combined with the Toxins of Erysipelas and Bacillus Prodigiosus. G. C., 16 years old, enjoyed good health up to 1903, when he had an attack of what was considered pleurisy with effusion. He was aspirated, but the dullness over the chest persisted and he rapidly lost flesh and strength. In October, 1903, he entered the Johns Hopkins Hospital where he was operated upon for supposed empyema. A large incision was made showing necrosis of the eighth and ninth ribs and behind these some gelatinous masses were found. These were partially removed and examination by Dr. Welch proved them to be round-celled sarcoma. The patient was referred to me on May 26, 1904, and placed under the combined toxin and X-ray treatment at the General Memorial Hospital for two months. The improvement was very rapid and when the patient left the hospital in the fall of 1904 there was no trace of the tumor left; he had gained 25 lbs. in weight and seemed in perfect health. The toxin treatment was continued by his family physician at his home in Canada. By the end of January, 1905, the patient returned to New York with a local recurrence which, although showing slight improvement at first, soon began to increase in size despite large doses of the toxins

plus regular X-ray treatment. After a thorough curettement in March and again in June, the patient was sent home, his condition being hopeless. According to advices received from his family physician, the end is expected daily.

Case 6. Inoperable Intra-abdominal Sarcoma Involving Mesentery, Mesenteric Glands and a Portion of the Small Intestine. Mrs. W., was operated upon in November, 1903, by Dr. Wm. M. Conant, of Boston, for abdominal tumor. It was thought to be connected with the uterus or ovary, but an infiltration into the small intestine was found. There was also in the posterior peritoneal part of the mesentery a growth fully as large as the closed fist. The growth was so extensive and suspicious that no attempt was made to remove it. Pathological examinations made by Drs. W. F. Whitney and A. C. Potter proved the disease to be round-celled sarcoma. The patient was then referred to me by Dr. Conant, and I placed her under the mixed toxin and X-ray treatment. The tumor entirely disappeared within four months time. A little later the patient developed high temperature with acute abdominal symptoms, pointing to local peritonitis. She was seriously ill and it was thought she would not survive the attack. A faecal fistula finally developed and she slowly recovered her health, remaining free from recurrence until January, 1905, when a small mass was detected in the lower portion of the abdomen, at the site of the original tumor. The treatment was resumed by her former physician, Dr. W. E. Wilson, of Pawtucket, and although the growth has not disappeared, there has been improvement.

In the great majority of cases little or no effect upon the sarcoma was noticed, although the treatment was pushed to extreme limits. A few cases, however, are worthy of special note:

One case, a very rapidly growing sarcoma of the orbit, with extensive involvement of the lymphatic glands of the neck, showed marked improvement almost immediately after beginning the exposures to the X-ray. The glands of the neck almost entirely disappeared under three to four weeks' treatment and the tumor of the orbit showed considerable decrease in size. The improvement was very temporary, however. The tumor soon began to increase rapidly in spite of continuous treatment, causing death about three months later.

I have used the X-ray upon three cases of melanotic sarcoma originating in the skin about the ankle, in two cases involving femur and iliac glands. In one of these, a rather slow growth, upon which four to five operations had been previously performed, and which, at the time when the X-ray treatment was begun, showed marked involvement of the iliac glands, the disease seems to have been arrested and life much prolonged, the patient remaining fairly comfortable for nearly two years, when death ensued. In the other two cases the treatment showed absolutely no effect upon the small nodules in the skin about the ankle nor upon the deep-seated glands in one of these cases.

In my efforts to trace to final results in certain reported successful cases of deep-seated malignant tumors treated by other men, I have found the following:

Case 1. Round-celled Sarcoma of the Neck, treated by Dr. C. E. Skinner, of New Haven, and published by Dr. Frank A. Kirby. (Journal of Advanced Therapeutics, February, 1902.) The patient, male, aged 64 years, in 1899 received a blow upon the neck from a wagon-pole, leaving a contusion which lasted about a week. Two months later a swelling was noticed at the site of the injury. This grew very slowly for about 16 months, when the patient severely wrenched his neck. Almost immediately afterwards the tumor began to grow more rapidly and became painful. By November, 1901, it had become very large, occupying the greater portion of the left mastoid and cervical region. Microscopical examination by Dr. Archibald McNeal, of the New Haven Board of Health, showed the growth to be round-celled sarcoma. The X-ray treatment was begun on November 20, 1901, by Dr. Skinner, who states that, in the incredibly short space of time of six weeks, the patient was apparently cured, the tumor having disappeared and the patient being free from pain and able to resume his work.

On June 27, 1902, I made a personal examination of this case and found absolutely no trace of a recurrent growth in the left side of the neck and mastoid region. In the lower part of the cervical region, however, I detected on deep pressure a very slight enlargement of one or two of the deep cervical glands.

In a letter received in the latter part of 1903, the patient's physician stated that he began to lose rapidly in general health,

and died about five months later. While no autopsy was made, there is little doubt that his death was due to internal metastases.

Case 2. Small Round-celled Sarcoma of the Neck, six times recurrent and apparently absolutely hopeless, in a man 70 years of age. The X-ray treatment was begun by Dr. E. R. Fiske, of Brooklyn, on December 22, 1901. The treatment was continued for a year, with occasional intervals of rest. At the X-ray meeting of the Academy of Medicine on March 9, 1902, I showed the patient in perfect health, there being not the slightest suspicion of a tumor or induration in the neck. On January 23, 1903, I learned from Dr. Fiske, that the patient was free from recurrence, in excellent health and had gained in weight. Less than a year after this, I received a letter in which it was stated that the patient had died on September 23rd, 1903, under symptoms of cerebral thrombosis. Here again there is a strong probability that death was due to generalization of the disease.

Similar to the foregoing has been the usual course of nearly all the primarily apparently successful cases that have come to my notice. The only exception to this rule of recurrence after X-ray treatment may possibly be found in the case of large fibrosarcoma of the abdomen treated by Skinner. The history of this case is so remarkable that it merits a brief resumé:

M. G. H., female, thirty-four years old, was referred to me by Dr. Maurice H. Richardson, of Boston, on April 19, 1901. She had been operated upon three years before for what was supposed to be a fibro-adenoma of the uterus; tubes and ovaries were removed. No microscopical examination was made. Two months prior to her coming to me, she had noticed a large tumor in the lower part of the abdomen in the region of the cicatrix. Physical examination at that time showed a tumor the size of a cocoanut in the lower part of the abdomen, filling up the entire iliac fossa extending nearly to the umbilicus, two inches beyond the median line to the left. The tumor was firmly fixed and seemed to involve the abdominal wall. An incision was made under cocaine, and a portion of the growth, which infiltrated all the muscles of the abdominal wall, was removed, and on microscopical examination proved to be fibrosarcoma. I used the erysipelas and Bacillus prodigiosus toxins more or less constantly until January, 1902, at first with marked diminution in the size

of the tumor, but later with very little effect, and, finally, the tumor began to grow in size very rapidly. I regarded the case as entirely hopeless. The patient had lost much weight and had begun to be cachectic. The X-ray treatment was begun by Dr. Clarence E. Skinner, of New Haven, on January 28, 1902. Forty-six applications were given up to June 5, by which time the lateral circumference of the tumor had increased from thirteen and three-quarters to fifteen inches. She had had several attacks of fever lasting for a few days, with symptoms of toxæmia, probably from absorption. Her general health, however, improved considerably during this time. From June to September she received thirty-one treatments, and during this time there was so much local and general improvement that she decided to resume her work as a school-teacher. Up to April 25, 1903, or 234 days, she received forty-six treatments, or about one treatment in five days. There was a marked decrease in the size of the tumor. From April 25 to August 29, 1903, she received only eight treatments, or one every two weeks. She had gained eleven pounds since the beginning of the treatment. From August, 1903, till May 20, 1904, she received only five treatments, or one every thirty-seven days. By this time her weight had increased to 147 pounds, being nineteen pounds more than in the beginning, and the tumor had entirely disappeared. In July, 1904, I examined the patient and was unable to detect any evidence of a tumor. The entire period of treatment extended over 849 days, during which time 136 treatments were given.

While it is true that only one year has elapsed since the cessation of the treatment and disappearance of the tumor, it is nevertheless the most remarkable case on record, I think, considering the very large size of the growth and its deep-seated location, although, of course, it is quite too soon to consider it a cure.

In a letter dated June 4, 1905, the patient states that she is in perfect health, and has had no return of the tumor.

The use of the X-ray as a pre-operative measure in primary malignant tumors, has been strongly advocated by some, especially Morton, of New York. The reason advanced in support of this plan is, that the previous X-ray treatment clears up the field of operation, in that it causes decrease in the size of

the tumor itself, and often subsidence or disappearance of the outlying glands. If at the end of a few weeks' treatment the tumor has not disappeared, it is argued that an operation of lesser magnitude or one under more favorable conditions can be performed, than would otherwise have been the case.

My opinion is that this pre-operative use of the X-rays in primary operable malignant tumors, particularly in sarcoma, is a very dangerous practice. The objections to it, which I have already pointed out in an earlier paper, are briefly as follows:

The method rests upon two false assumptions.

1. It presupposes that we are dealing with a curative agent;

2. It takes for granted that no harm can come to the patient during these weeks of treatment.

The facts up to the present moment fail to show that the X-rays are curative of malignant tumors in any other form than the small, superficial epitheliomas. In deep-seated cancer, including sarcoma, there have been very few cases in which the tumors have disappeared entirely and, as far as I am able to judge, not only from personal experience, but also from a very careful study of the literature of the reported cases, no patient has remained free from a local or general recurrence for a period of three years, the shortest time required to justify us in considering a case a cure.

Another grave danger from putting off operation until the X-ray has been first tried, is the possibility of generalization of the disease either by the treatment itself, or coincidentally with the same. Personally I have observed a number of cases of primary or recurrent cancer of the breast become much smaller under the X-ray treatment and, in a few instances, the tumor apparently disappeared altogether; yet, at this very time the disease was insidiously extending into the neighboring glandular areas, or was being carried by the circulation into the general system, causing metastases. In some of these cases the extension was so unusually rapid, that I have become convinced that the breaking-down of tumor tissue which occurs before absorption takes place, not infrequently permits infected cells to get into the circulation, giving rise to general dissemination of the disease. I have already given brief histories of two of the cases which helped to confirm this my belief, one was a lympho-sar-

coma of the neck, the type of tumor in which general dissemination is rarely found. Yet in this case, almost immediately after the disappearance of large tumor masses in the neck and cervical region, there appeared large tumors in the groin and in the retroperitoneal glands. Finally, just before death, hundreds of tumors developed subcutaneously in almost every portion of the body.

In another case, a round-celled sarcoma of the femur, while the primary tumor was diminishing in size, there developed a large metastatic growth in the left pectoral region and almost simultaneously a large tumor, the size of a child's head, in the right retro-peritoneal region.

The value of the X-ray as a prophylactic after operation for primary sarcoma is, I believe, as yet undetermined. In a number of cases, both of sarcoma and carcinoma, I have used the X-rays immediately after primary operation with the hope of preventing a return. In nearly all of these cases, however, a recurrence has taken place early and small, almost imperceptible nodules have grown apparently quite as rapidly under the exposures to the X-rays, as if no treatment had been used.

It would require a much larger number of cases and much more data as regards character of the tumor and the period of observation, than we have at present, to express any authoritative opinion upon this point.

My own feeling, based upon my experience thus far, is that there is not sufficient evidence to justify us in advocating the X-ray treatment as a routine measure after primary operations for either sarcoma or carcinoma. As a further factor in support of this opinion might be mentioned the danger of the X-rays themselves producing cancer in normal tissue. That such a result may take place is evidenced by at least four cases in which cancer has developed in the hands of X-ray workers.

CONCLUSIONS.

The results of the treatment of sarcoma with the X-rays thus far have shown:

1. That the great majority of cases are but little affected by the use of the X-rays.

2. That in a certain small proportion of cases the tumor decreases rapidly in size, and in a few instances, may totally disappear.

3. That in all of the cases so far observed, with one exception, there has been either local or general recurrence, although in some few cases life has undoubtedly been considerably prolonged.

4. The very small percentage of cases in which the tumor has disappeared and the almost universal tendency to early recurrence even in these cases, added to the danger of possible dissemination because of the treatment itself, are sufficient reasons for never advocating the method except in inoperable or recurrent cases.

5. The facts thus far furnish no evidence that the X-ray has any prophylactic value when used after primary operation.

DISCUSSION.

DR. GORDON G. BURDICK, Chicago: I have been very much interested in this paper. I have used the Doctor's toxins very liberally in years past, and I still use them. My results have been a little more favorable than Dr. Coley's. While I was a surgeon I took out many sarcomas, long before I began to use the X-ray. In sarcoma I was taught to expect a recurrence nearly every time I operated.

I began to use the X-ray in sarcoma by accident. I was very anxious to get a skiagraph of a sarcoma of the shoulder with a very inefficient apparatus. I had been using a tube that had been used around the hospital for a considerable length of time. It was not a very efficient tube. I tried for a long time to get a picture of this sarcoma, and I finally succeeded in getting a picture that showed the outline of the tumor, but much to my surprise the sarcoma began to disappear very rapidly, and that case is still alive to-day, although there has been a little recurrence under the arm in a spot that had been protected by the lead foil.

I found that, as a rule, these cases reacted very nicely to the ray. Then I got a lot of new tubes, but none of my sarcoma cases got better when I used these new tubes; in fact, they get

worse. Then I began to experiment. I got a lot of old tubes that had been running every day for a long time and in that lot I found one or two tubes that seemed to have a favorable influence on the sarcoma. Then I broke a number of them to find out what the thickness of the glass was and the arrangement of the tube. I found that the tubes that were thickly coated with platinum on the inside were the most effective.

I had one patient, a young man, who had multiple sarcomas all over the body originating in a sarcoma of the jaw. All these tumors disappeared, except twelve. One tumor in the mouth did not show a disposition to disappear very rapidly, although it shrank to nearly one-third its original size. Then he fell into the hands of a surgeon who operated on him. Death followed in forty-eight hours from sepsis. The diagnosis in this case was verified by a number of our best pathologists and surgeons.

There is a great deal in the adjustment of the tube. I have found that we must not use any treatment that will irritate; the less irritation the better. It is wrong to burn these sarcoma cases. Of course, sometimes a little irritation will help these cases, but as a rule it will not. The proper treatment is slow persistent radiation with a tube so thoroughly protected that no soft rays reach the tissues. Then you can ray the tumor for months without the slightest irritation, except, perhaps, a little tanning of the skin. You will find a change taking place slowly.

The case of tumor of the brachial plexus which I reported, and which was supposed to be an aneurism, was sent to me for treatment because the surgeon could not contemplate its removal with satisfaction. I tried the X-ray on it for nearly three months, and finally the skin over the tumor became so irritable that I did not deem it wise to continue the treatment. That proved to be a round-cell sarcoma and a small number of the characteristic tumor cells were found nearly one and a half inch beyond the edge of the tumor, the rest having undergone fatty degeneration. The patient was operated on three years ago and he is alive to-day and in good health.

Dr. Bowen, Columbus, O.: My experience agrees with that of Dr. Burdick, in the use of the high vacuum tube. I have treated 12 cases of sarcoma. One case, a recurrent sarcoma of

the sternum, was treated with the X-ray for six months, and cured. This patient has remained entirely well for a period of three and one-half years. Two other cases were recurrent sarcoma in the abdomen. One of these cases, I have treated for three years, the other for two years, and both are almost well. I am still continuing the treatment in these cases. The diagnoses in all my cases were confirmed microscopically.

In the last three cases which I have treated, I used Coley's serum, in conjunction with the X-ray work, and the results were bad. With this combination, I found that the skin was more easily irritated with the X-ray treatments. After the burn once developed, the treatment seemed to have no further effect.

In the case in which I had satisfactory results, I used old tubes, which had a high penetrating power. The treatments were kept up for a long time, and no burn was produced. To this I attribute the success of the treatment.

DR. KENNON DUNHAM, Cincinnati, O.: I want to endorse what Dr. Burdick said about old tubes. Those are the tubes with which to get results in sarcomas and deep-seated tumors.

DR. J. RUDIS-JICINSKY, Cedar Rapids, Ia.: In cases of sarcoma which I had and where I had comparatively good results, I always rayed before and after operation. Perhaps I made a mistake, but I am satisfied with the result.

We talk about the prophylaxis of the X-ray; whether it has any value or whether it has none. How would we explain the results we obtain in leukemia? What is leukemia? It is a sarcomatosis of the blood and the blood-forming organs. What does the X-ray accomplish in this disease? We relieve the patient from suffering and we prolong life. Is that not enough for the X-ray?

DR. STEVENS, Detroit, Mich.: My experience with the X-ray has been mostly along the line of skin work, but what little experience I have had in the treatment of sarcoma has been favorable rather than otherwise. In one case referred to me about a year ago, a spindle-celled sarcoma had been removed from the thigh of a man 80 years of age, and the diagnosis con-

firmed microscopically by Dr. P. M. Hickey, of Detroit. It recurred within three months, was removed again and was then referred to me for X-ray treatment. It was treated with a Gundlach tube excited by a 12-inch coil for three months, and there has been no sign of recurrence in a year. I do not report this case as cured, however, as the time is too short.

Another case was one of Kaposis idiopathic multiple pigment—sarcoma of the skin, with tumors the size of a pea to the size of a plum, and one the size of a cherry hanging from each lower eyelid in a man aged 72. There were many tumors on the backs and fronts of the hands and feet, on the penis, tongue, palate and a few scattered elsewhere. The case was located at my clinic at the University of Michigan where the apparatus used was very inefficient, being a 24-plate static machine which did not operate very well, and later a nine-inch coil operated by a storage battery. The tube was an old one, and heavily coated on the inside. Most of the tumors disappeared after three or four months' treatment. Dr. Warthin, of Ann Arbor, confirmed microscopically the diagnosis of round and spindle cell sarcoma from growths taken from eyelid and sole of foot. Nearly all the tumors disappeared during a year's treatment under these rather unfavorable circumstances, and the old man, who was at first confined to bed, is now walking around and feeling quite well.

If the X-ray will remove such tumors as those on the surface, it seems to me that it is only a matter of technic and time when we shall be able to do the same thing with deeper seated growths, when we can prevent the irritation of the intervening structures.

In the first case I mentioned there was no irritation produced by the ray. In the second case there was a mild dermatitis. I also treated a case of sarcoma involving the greater portion of the abdomen, operated on by Dr. MacArthur, of Chicago, but not removed. The patient was moribund, being very cachectic oedematous and wasted. He suffered excruciating pain. The diagnosis was confirmed microscopically. I gave the man a month's X-ray treatment with practically no effect. Then, I also treated him with Lieber's radium coatings, using a piece three inches square of 10,000 activity. That relieved the pain at once and almost entirely, the X-ray having failed to do so. The

radium produced a slight dermatitis within 48 hours, after a twelve hours' application. The patient died.

DR. A. L. GRAY, Richmond, Va.: The point has been brought out in this discussion of the value of old tubes. One gentleman spoke of a deposit of platinum and the other spoke of a deposit of aluminum, on the inside of the tube. We all recognize that the seasoned tube is to be preferred to one that is not seasoned, but I would like to know whether it is a deposit of platinum or a deposit of aluminum, and whether a film of aluminum or platinum foil would not have the same effect as this deposit.

DR. M. K. KASSABIAN, Philadelphia: I had a case about three years ago of a man, age 35 years, with a large sarcoma of the leg, near the ankle. The man was operated upon but the tumor recurred, even though post operative X-ray treatment had been given. He was operated on again. I made a hole in the lead about the size of half a dollar and exposed this portion for three months to the X-ray. The sarcoma returned, not in the site of the original tumor but around the margin in a spot which I did not expose to the rays.

In treating these post operative cases we must always expose an area three or four times larger than that of the original tumor.

DR. GEO. E. PFAHLER, Philadelphia: There has been considerable discussion about the removal of certain rays in the treatment of these deep-seated affections. During the past four months I have been making use of a little device which has given me entire satisfaction. I have called it the "Rœntgen Ray Filter." It cuts out entirely these objectionable rays. I shall present the filter to you later in the course of the meeting.

I recall a case I reported about two years ago, a sarcoma of the orbit, which disappeared very nicely under treatment and it remained well. She then drifted into the hands of a nose and throat specialist who saw a little turbinated bone that he thought projected too far into the nose and he decided to amputate it. He did, and a month later the patient died apparently from a

recurrence in the sphenoidal region, showing a rather rapid development of sarcoma after operation following an apparently successful cure with the X-ray.

VERNON J. WILLEY, Ann Arbor, Mich.: The method we have been using in the University Hospital in the treatment of sarcoma has been to treat the patient for from two to four weeks before operation, and I always used an old hard tube enclosed in a Friendlander shield, the front of the aperture being covered with one or two layers of tin foil so as to get rid of the soft rays. We have had fairly good results. At least our surgeons and pathologists think so.

I have had but one case that was treated entirely by the X-rays, and, unfortunately, no pathologic examination was made in that case. The patient apparently recovered after 42 treatments. That was over a year ago, and there has not been any recurrence since. The surgeon who referred the patient to me is, however, inclined to think that the growth was not sarcoma, on account of the good result.

DR. GEO. C. JOHNSTON, Pittsburg: I have treated quite a number of cases of sarcoma and at one time I thought I was quite successful in the treatment of these tumors, but I have never been able to duplicate my results. I have three cases of inoperable sarcoma alive and well more than three years after treatment. Since then I have treated quite a few cases of sarcoma, but in not one of these cases have I been able to approximate the results obtained in my early cases. The fact of the matter is that I know more about the X-ray now than I did three years ago, and I know more about sarcoma now than I did before, but I have not had that particular kind of sarcoma come for treatment that can be cured with the X-ray. When it does come, I expect to cure it.

This is one instance where our discussion means little more than nothing. We talk about sarcoma and we say that the diagnosis was confirmed microscopically, but that does not mean much. It does not tell us the degree of malignancy of the tumor. It does not help us much in our prognosis.

I always use a hard tube; in fact, the harder the sarcoma, the harder the tube. I remember when I first saw Dr. Coley's toxins used in the treatment of sarcoma. It was during my last year in college that I saw it used in several cases of sarcoma of the neck. I thought it was wonderful. I saw the tumors actually melt down and disappear. But a year later the same patients came back to the hospital with another sarcoma. The patients get well once, but after there is a recurrence, the result of the treatment is not the same as it was in the case of the primary tumor. I believe that with a combination of these toxins and the X-ray much can be done.

I am not very enthusiastic about the cure of sarcoma by the knife. I have not seen many cases cured that way, but in the combination of the toxins with the X-ray I see a chance for doing good work.

Dr. Coley, closing the discussion: I agree thoroughly with Dr. Burdick in what he said about the old and hard tube. Practically all my successful cases were obtained with such a tube. I would also like to emphasize strongly the point made by Dr. Kassabian showing that it is very unwise to treat tumors by putting a shield over them, covering them up no matter whether or not the surrounding tissues are involved. Allow an area as large as possible in the vicinity of the tumor to get the benefit of the X-rays.

One word about the pre-operative use of the X-ray. I do not think that we have brought out sufficiently strong some of the dangers of using the X-ray as a pre-operative measure. A short time ago a patient came to me with an epithelioma of the lip. It had been treated by the X-ray and after thirteen treatments the tumor disappeared and the patient supposed that he was cured. The tumor recurred in six weeks and the X-ray no longer was of any benefit. When the case came to the surgeon for operation, a large part of the lip and many glands in the neck were involved and the case had become inoperable.

I also had a case of carcinoma of the tongue in which the X-ray was tried prophylactically. When the case came to the surgeon the tongue and all the glands in the neck were involved and inoperable.

In regard to the possibility of curing sarcoma by operation, I think the society has a rather pessimistic idea as to what can be accomplished by surgery. I would refer you to Dr. McCosh's paper in the Journal of the American Medical Association. He collected 125 cases operated upon at the Presbyterian Hospital and succeeded in following the after history of most of these cases. I believe that the permanent cures were not far from 30 per cent.,* so that surgery can cure many cases of carcinoma and sarcoma, and until we can establish the fact that it is possible with the X-ray to cure a larger percentage of cases than by operation and to destroy small recurrent or inoperable tumors, destroy small recurrent or inoperable tumors, we ought to leave we ought to leave operable, easily removable tumors to the surgeon. There is plenty of opportunity for the X-ray in inoperable tumors.

I only referred to the toxins in an incidental way as was necessary in conjunction with the cases reported. Dr. J. Rudis-Jicinsky has brought out the fact that the toxins may produce metastases. I do not say they may not; in fact, judging from the fact that they break down tumors and produce a rapid degeneration, it is possible that the same danger exists in the use of the toxins as in the use of the X-ray. I have had no cases thus far, however, which pointed so conclusively to such a result taking place as is the case with the X-ray. However, I have never used the toxins nor have I advocated their use except in hopeless inoperable cases, in which it is also perfectly justifiable to try the X-rays.

As regards the results of the use of the toxins, they no longer rest on my individual statement. Many others have used them successfully, and at the present time I have nearly thirty cases that have been well from three to thirteen years, in which the clinical diagnosis made by leading surgeons was confirmed by microscopical reports of our most experienced pathologists.

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*Of the 125 cases in McCosh's statistics, the after history was traced in only 98 cases of them, 32 or 33 per cent. were well over three years.

Roentgen Therapy of Carcinoma

BY G. H. STOVER, M.D.,
Of Denver, Colorado.

It is now a well established fact that the Rœntgen ray has curative properties which are of use in many pathological conditions. We have passed the time when debate on this proposition is called for.

Now our attention is more given to methods and technique.

I began using the Rœntgen ray early in 1896 when but little was written on the subject, and I was not surrounded by colleagues in the same work with whom I could exchange ideas and discuss discoveries; therefore my technique has been largely of my own development; it has been a source of great satisfaction to me on my previous visits to your Eastern cities, to find that I had fallen upon methods similar to those used by the men here, who had larger opportunities than I to test them; therefore I probably have nothing new or startling to offer you.

In making some nine thousand therapeutic applications of the Rœntgen ray, I have made use of Scheidel 12-inch and 16-inch coils, Heinze 12-inch coil, Carstarphen 6-inch, 12-inch and 15-inch coils, three Kinraides, 6-inch Meyer coil, and static machines. Some of the coils have been operated on alternating current at 110 volts, others on direct current at 220 volts, and some by storage batteries; as interrupters I have been using all kinds: commutator breaks, hammer breaks, mercury jet, and electrolytic with acid or alkaline solutions. I have tried every type of tube, almost, that I know of; those with vacuum regulation are preferred, and by choice those of the automatic type.

The most important question we now have to deal with relates to the measurement of Rœntgen energy. A number of men have devised apparatus for the purpose. It is claimed by some that no standard dose can be established, by reason of the fact that normal tissues of different individuals are not alike in their

susceptibility to the rays, thus giving rise to the belief in an idiosyncrasy in certain individuals, rendering them very liable to Rœntgen ray burns. I do not believe this is of much importance. I believe there is less of an idiosyncrasy to the Rœntgen Rays than there is to drug action, and we certainly recognize a standard dose in drug therapeutics. I am almost willing to state dogmatically that the reported cases of idiosycrasy are those in which a low tube has been used, close to the skin; and before anyone disputes this statement I want him to be extremely sure of his grounds.

The measuring apparatus which has so far been presented is open to many objections; all of them are too costly and too complicated; some of them are cumbersome and would require too much time for adjustment with varying positions of the tube; the reading of some would be unfavorably affected by the presence of radium in the office; or by the influence of other electrical apparatus in action near them; some would not give the same reading under different conditions of the air with regard to the presence of varying amounts of dust or moisture, and altitude might be a disturbing factor. The discs of barium-platinocyanide change color partly by dehydration, it has recently been stated; the readings would be very different in Colorado from those in New York. The readings of those which measure the amount of current passing into the tube, with a control measure of parallel spark, probably do not truly indicate the actual output of rays because the walls of tubes vary so in thickness and in composition of glass used.

I think I have learned to estimate the amount and character of the rays being produced by considering a number of factors, among which are: amount of primary current, rate of interruption, kind of interrupter, character of wire and winding of secondary coil, tests of parallel spark gap, the visible fluorescence of the tube, and very rarely, a glance through the fluoroscope. All this sounds very cumbersome and time-consuming, but really the process is almost an unconscious cerebration. When a measuring instrument comes, convenient to use, uncomplicated and not of delicate construction, subject to few disturbing factors, and of reasonable price, I shall welcome it.

I simply try to get a ray of good mellow quality that will penetrate the tissues to be affected; it is from a rather lower vacuum tube than I would use in radiography of tissues of the same thickness. The rays of high vacuum tubes seem to me to be rather tenuous, and not to have as much chemical action as the others. It seems best not to get the tube too close to the skin as there are apparently rays, or an influence of some kind, close to the wall of a tube, of rather high destructiveness and not of easy control. The rays should not be confined too closely to the actual area under treatment, but should be permitted to affect the surrounding tissues to a reasonable distance. It is well to protect the eyeballs and the hairy portions of the face and head when they do not particularly need treatment; in most cases the testicles or ovaries ought to be protected. It is possible that a long series of applications reaching the internal ear may damage the hearing, but I do not know that this has happened. In making applications to the glands in the neck there may be danger of unfavorably affecting the pneumogastric, and in the treatment of carcinoma of the breast I have sometimes wondered if there was danger of injury to the lungs or the heart muscle. Case No. 2 received a long course of treatment for Paget's disease of the nipple, complicated by carcinoma; she completely recovered, but about a year later took a long walk in a hard storm, contracted pneumonia and died; her cancer was in the right breast, the pneumonia was in the right lung, an ordinary acute attack. Case No. 20 had been operated for carcinoma of the left breast, the Rœntgen ray applied to prevent a recurrence, which, however, occurred; a second operation was done, there was an immediate recurrence attended by extensive ulceration, when she again came to me. She was rayed for a time and while still under treatment developed what seemed to be an erysipelas of the skin of the body and arm on the left side; it was certainly not a burn for it first appeared on the arm, which had received no exposure at all. Within a very short time she had pneumonia of the left lung and died. Case No. 136 was supposed to be a very extensive example of carcinomatosis; both breasts were shrunken and indurated, and there was induration of the glands in each axilla and on both sides of the neck. No microscopic examination was permitted, so I used the Rœntgen

ray, but at the same time advised that she receive iodide of potassium. She recovered from the original condition completely, but soon had a severe attack of cardiac difficulty, and was in quite a precarious condition for a time. I have seen her quite recently and learned that her heart had given her no trouble for some time; in looking her over I found what seemed to be a rather typical gumma of the skin.

Cases Nos. 23 and 216, both of them very small and very thin women whom I have treated for recurrent carcinoma of the breast, have had symptoms resembling muscular rheumatism; one of them had been subject to the same symptoms before taking the Rœntgen treatment.

In treating carcinoma covered by healthy skin, it does not seem necessary to produce a dermatitis; in the cases that do best there occurs a slow atrophy of the skin, at times accompanied by pigmentation. The operator should be on the watch for an erythema that appears from two to six hours after an exposure, when a number have been given; an erythema that will have disappeared by the next day as a rule; when this has taken place a few times, it is well to omit exposures for a time or place longer intervals between them. In superficial carcinoma a little dermatitis does no harm, and is at times apparently of benefit.

I usually make applications three times a week, as this plan gives one a better control of reaction than when daily exposures are given. The average length of an exposure is ten minutes, and the tube is practically never less than eight to ten inches from the skin.

It is probably a good plan to send the rays into the tissues from different points during a course of treatment.

I use Friedlander shields on most of my tubes, to protect parts which it is not desired to expose, and also to keep the rays from reaching my assistant or myself.

As about 99 per cent. of my work is with referred cases, the diagnosis has usually been pretty well settled before they come to me. A microscopic examination has generally been made at the time of operation in the post operative recurrences that I see. In the primary cases I do not much like to urge the removal of a portion of the growth for examination as I have a strong dislike to have incisions made into the body of these growths; I

hope you can convince me that this feeling is a mistake. If I cannot differentiate between lupus, carcinoma of the skin and rodent ulcer, I have the satisfaction of knowing that the Rœntgen ray is the thing to use, even if I am not sure as to the name of the condition I am treating. I feel that I must subordinate my scientific interest in the case to the interests of the patient.

In carcinoma of the skin without involvement of neighboring glands I think the Rœntgen ray is as nearly a specific remedy as we can expect to possess. I have caused the entire disappearance of secondarily infected glands in several cases, which leads me to view the application of the ray to carcinomatous glands in certain primary cases with rather more favor than has been my habit in the past. Yet I think we should be very conservative about recommending the Rœntgen ray for glandular cases. In the case of Paget's disease above referred to, there was an enlarged and indurated gland just beyond the axillary border of the pectoralis major, which gland entirely disappeared under Rœntgen therapy. Case No. 179 was a post operative recurrence in glands on the side of the face and in the neck following the removal of a carcinoma of the skin just in front of the ear. Roentgen therapy caused the entire disappearance of one of them; some others were removed by operation and I had them examined by Dr. Wilder, who reported that the epithelial cells in one were very few, and that in another they showed distinct evidence of degeneration; there was a clear excess of connective tissue present. Case No. 94 was that of a young man only 25 years of age, who had a tumor of the lip; this was treated by a dermatologist who attempted to remove it with paste; it promptly recurred; the paste applications and recurrences were repeated several times. I gave a large number of Rœntgen treatments with apparently no good effect, so the growth was excised; microscopic examination showed it to be malignant, but I was unable to get any information as to pathological details; the glands under the jaw became involved and after a course of raying I asked to have them removed; the microscopic examination of these revealed considerable evidence of degeneration in the epithelial cells, and they could hardly be stained.

When I am consulted by a person who has a carcinoma beneath the skin, my position is as follows: I always advise treat-

ment by the Rœntgen ray of primary non-operative and recurrent non-operative cases; the percentage of success will always be very small in these classes of cases, but they come to us as a last resort, and we must do what we can for them, even though it is only to keep them out of the slough of despond into which a surrender to their fate must plunge them, or to lessen present misery in the hope of future benefit until kindly nature obtunds their senses as the end approaches. In the cases where it is an equal choice between Rœntgen treatment and surgical measures, I feel that the microscopic findings above referred to have to a certain extent led me to believe that perhaps I may somewhat modify my former conclusions. It seems to me that since I have been using fluorescin my results have been rather better than before. I formerly absolutely refused to treat any operable case of carcinoma beneath the skin; at the present time I say that I believe it my duty to advise operation and strongly urge it; if then the patient positively declines operation, I consent to treat them for a time, but I demand that there be present a considerable margin of safety, so that if operation is needed later its success will not have been imperiled by the delay in resorting to it, and in talking to such a patient I never lose sight of the fact that an operation may be needed later; if such a case shows improvement, it is well; if it must come to operation I have not done harm; indeed, it is quite probable that a preliminary raying is of benefit.

I believe that Rœntgen therapy should be made use of after operation, but I am unable to decide when it should be applied, whether immediately after operation in order to prevent a recurrence, or whether one should wait until a recurrence has manifested itself. My own experience with the prophylactic treatment has resulted in failure; a recurrence has taken place in a majority of such cases, though not in all; I am inclined to believe that the treatment was not continued long enough and perhaps also was not sufficiently vigorous. I shall continue to make prophylactic use of the ray for a time, in view of this belief, until more data has been obtained.

Case 23. Referred by Dr. Leonard Freeman. Mrs. G. VanB, aged 36. A sister has cancer of breast. Five or six months before coming to me this patient found a small lump in her right breast. A complete radical operation was done and two months after the operation she was re-

ferred to me for prophylactic treatment. Treatment was given once a week for six months, stopping Jan. 31, 1903, there being no evidence of recurrence. In October, 1903, she came to me, having had two recurrent points of disease removed, one in a gland in the axilla and the other a small mass formed about a piece of ligature that had been left. Treatments were given on alternate days during the month of October, then omitted until December, and continued until February, 1904, when she went East on a visit. After her return she suffered great pain in the back and chest and was supposed to have spinal involvement; there were indurated glands in the axilla and neck on the right side and a lump appeared in the left breast; the case appeared hopeless, but treatments seemed to reduce the size of the glands and the lump in the breast almost disappeared; her pain was so great and her general condition so bad that it seemed useless to continue as she was hardly able to get to the office; there were some indurated glands in the neck on the left side. Since that time, it is nearly a year now, the progress of the disease seems to have been arrested; she still has pain but it is not so severe as formerly, and she is able to do a good deal of her housework, her husband tells me. There is no doubt about the diagnosis of this case as several microscopic examinations were made at different times. I do not think I treated her long enough when she first came to me, or often enough by a good deal. It is almost miraculous that this patient is alive to-day; when I discontinued treating her, we all thought she could not live more than a month or two.

DISCUSSION.

Dr. Price, Scranton, Pa.: I would like to ascertain whether any one present has found that syphilitics are more susceptible to the X-rays than those who are not infected with syphilis. It has been so in my experience; in fact, when dermatitis comes on quickly I always suspect syphilis.

Dr. Charles F. Stokes, U. S. N.: I would like to ask Dr. Stover whether he has had any experience in the treatment of superficial cancer of the face that exists in two places. Last winter I had a case referred to me with an epithelioma on the left cheek and a second, about the size of a nickel, on the left side of the nose. The tumor on the cheek yielded very nicely to exposures of three minutes, twice a week, anodal distance eight to ten inches, and a low amperage. The growth on the nose was extremely sluggish and is only now beginning to yield to more prolonged exposures and more frequent exposures. The diagnosis was verified microscopically.

Dr. George E. Pfahler, Philadelphia: Dr. Stover's paper has been exceedingly interesting, especially his statement con-

cerning the lungs. I do not believe, however, that his suggestion regarding the increased susceptibility to pneumonia can be taken very seriously because we know of the great tendency to the development of pneumonia, independent of the X-ray treatment, and I do not think that we have any right to draw such conclusions because these patients develop pneumonia.

I have had some results in cases treated at least 150 times over the chest and both sides that I would like to mention and ask for an explanation. I treated the patient for mediastinal carcinoma for about a year and a half and she seems to be well, except that her breath sounds are a little harsh; that is, the physical signs are those of fibroid phthisis. It occurred to me that possibly there is an increase in the production of fibrous tissue in these lungs just as we get as the result of much raying in other tissues. I would like to know whether other members of the society have had similar results.

Dr. Stover, closing the discussion: I have not noticed that syphilitics are especially susceptible to the rays. I remember applying the rays to a gumma of the hand that disappeared after three exposures. I would hardly expect any tumor to disappear as quickly as that, so that it may have been susceptibility to the rays that would account for such a result.

The cases I mentioned, where both breasts and many glands were involved, usually got a lot of exposures without a sign of dermatitis, not even an erythema.

I have not seen superficial carcinoma in two widely different locations, hence I do not know whether there is any difference in the reaction to the ray in the two tumors, although we do know that cancers in different parts of the face do react differently to the ray. An epithelioma near the internal canthus is much harder to treat than one farther out toward the outer canthus. An epithelioma on the lip is harder to handle than one on the cheek, probably due to the difference in the character of the cells in which the tumors originate.

As to increasing the susceptibility to pneumonia in chest cases, I simply mentioned this because I noticed the peculiar coincidence in the two cases I mentioned, and desired to learn if any other operators had had a similar experience.

Accuracy in Diagnosing Calculi.

BY RUSSELL H. BOGGS, M.D.,
Of Pittsburgh, Pa.

In order to obtain accuracy in the Rœntgen diagnosis of calculi, it is necessary to be a diagnostician as well as a good radiographer. A diagnostician cannot become familiar with all the symptoms and be able to differentiate diseases in a short time any more than a radiographer can become an expert in making pictures of calculi in the urinary tract. Both require considerable time and experience in order to do successful work and operators must be familiar with the symptoms of calculi and also must be able to make a good radiograph as well as interpret it. These two factors cannot be too strongly emphasized.

One of the greatest drawbacks in the past has been that the physician is not familiar with the densities which may appear on the plate and cannot interpret them.

Renal colic may be caused by sand which afterwards may be passed, and then when a radiograph is made no stone will be shown. This undoubtedly accounts for the renal colic which is often present, the cause of which cannot be detected by the X-ray. Operations have proven this to be a fact. It is a well known fact that microscopical concretions form in the kidneys and may produce renal colic in the patient, but within a few hours these concretions have passed and the patient will not have an attack for some time. Uric acid crystals form in the urinary tract and may cause renal colic and yet within a few hours the patient is in a normal condition. Then, of course, when the patient is examined by the X-ray, no stone will be found. As before stated, this has been proven by operation a number of times, but when a patient has renal colic it certainly is advisable to make a radiograph, because we do not know whether the colic is caused by uric acid crystals or by a stone.

In over 200 cases which I have examined by the X-ray, I have only two unsatisfactory results to report. One was a patient who had been previously examined by the X-ray and a negative diagnosis made. My radiograph showed a stone in the left kidney about the size of a marble and also a density in the right kidney. I reported this to the physician and surgeon and stated that from the shape of the stone I was positive there was a stone in the left kidney, but that the density in the right kidney might be due to an imperfection in the plate, and therefore wanted to make a second examination. As the patient was extremely nervous, both the physician and surgeon refused to have this done, as they were sure that a stone was present in each kidney. The subsequent operation proved a stone to be present in the left kidney, but nothing in the right.

The second case was a patient with a stone in the ureter and the reason for reporting this case in detail is to show that I did not carefully interpret the plate. It was a stone composed of uric acid which did not cast a dense shadow and I made a negative diagnosis as soon as the plate came out of the hypo. The radiograph showed the necessary detail and the next day the patient was operated upon and a small stone about the size of a pea was found. The surgeon and myself, the day after the operation, when the plate was dry, studied the plate and saw a stone in the ureter. This certainly shows the necessity of making a good plate and interpreting the same and taking into regard the symptoms of the patient before making a diagnosis of calculi. A diagnosis should never be made from a plate until it is perfectly dry and can be studied by daylight and by a ground glass negative reader.

The calculi which are most frequently present are composed of uric acid, calcium-oxalate and phosphates. In any case it is not difficult to make a radiograph which will show the calcium-oxalate and phosphate stones, but, if the patient is extremely large, it requires a great deal of accuracy in order to show the necessary detail to make a negative and positive diagnosis.

The symptoms present in calculi are rarely sufficient to justify a positive diagnosis and up to the present time the Rœntgen Ray has proven the most efficient method. The various operators differ in their estimate of the value of this method, but

their results are always contingent upon the study of the cases and their technic. The physician who has not made at least eight or ten radiographs showing stones in the urinary tract and who is not able to show the necessary detail in order to determine whether calculi are present or not, should not be considered competent to use the rays for this purpose. This is the most important work a radiographer is asked to undertake and he should consider that, unless he has had experience, it would be wise for him not to attempt to examine these cases.

It has been agreed upon by a large number of operators, that a plate, in order to be of value in the diagnosis of kidney-stone, should show every articulation, the spinous and transverse processes of the vertebrae, the outline of the last two ribs and the psoas muscle, and a radiograph to show a stone in the bladder should show all details in bony structure of the pelvis. By studying the plates of various operators, it will be seen that the standard shows that these details vary greatly.

The amount of knowledge gained from examining a radiograph depends entirely upon the experience of the operator. Too much stress cannot be laid upon the interpretation of the negative, otherwise small calculi composed of uric acid may be overlooked. Great care should be taken in making these radiographs, otherwise an imperfection in the plate might be mistaken for a calculus. This shows the necessity of taking two radiographs before making a positive diagnosis. The laity may be glad that nearly all the hospitals have realized that it requires more knowledge of medicine and electricity than the head nurse or some other inexperienced party possesses to make a careful diagnosis of calculi.

It has been the experience in the past that many make radiograms which do not come up to the standard, and a negative diagnosis is the consequence.

The method of making radiograms of calculi differs greatly by different authorities, but each realizes the importance of showing the necessary detail before either a positive or negative diagnosis can be made. One will advocate an exposure of a few seconds, while another will advocate a longer exposure, even as long as ten minutes. I feel quite sure that the shorter the exposure the better the radiogram will be, because there is no

motion of the parts, and, besides, when you use the rays intense enough to make a picture in less than 30 or 40 seconds, you will use a tube which is much lower in vacuum and which will give greater detail and greater differentiation. My experience has been that every radiogram should be made while the patient holds his or her breath and then there is no movement of the organs in the body.

The time of exposure has been discussed to considerable extent, and some using a small coil excited by a storage battery, advocate 5 to 10 minutes, but in using this technic you are bound to set up more secondary rays during the exposure, even if the coil has practically no inverse discharge, than by using a large amount of current for 30 seconds with all the inverse discharge cut out. In the former method it would only be necessary to use a small milliamperage in order to pass the same amount of rays through the body in the given time, but with the second method, which seems to me the better, you can pass 5 to 8 milliamperes through the tube for 30 seconds, and by using a rheostat in series with the primary of the induction coil, the milliamperage can be kept at a certain point.

One great difficulty in using a large amount of milliamperage and a quick exposure is that it requires a more stable tube. Few tubes will hold their vacuum for any length of time and this is one of the difficulties encountered in making radiograms of calculi, but with the slower method it is easier to judge the vacuum of your tube, because if the tube fluctuated for a short time during the exposure, a better picture may be produced than if it fluctuated during a quick exposure.

Stone in the ureter may simulate appendicitis. There have been a few cases reported which have been diagnosed as appendicitis, but which a radiogram subsequently showed to be a stone in the ureter. I have had five such cases.

DISCUSSION.

Dr. Henry K. Pancoast, Philadelphia: Dr. Boggs is to be congratulated upon his technic and his experience in not having more errors in diagnosis, as most men have had a higher percentage than he has had. I find that some of the best sur-

geons will not accept an X-ray diagnosis from anyone as positive unless there are present a sufficient number of the classical symptoms of calculus to warrant the diagnosis without the X-ray findings. The greatest difficulty seems to be in the interpretation of calculi in the lower portions of the ureters. In most of my cases of this kind the shadows were afterwards in one way or another found to be due to stone. There are, however, many sources of error in the diagnosis of calculi in this region. Recently, in one case of a patient with symptoms of renal calculus a shadow was noted in such a position as to indicate a ureteral stone. The nurse reported the next day that the patient had passed a stone and a second skiagraph failed to show the shadow. A day later fragments of another supposed stone were passed. Neither skiagraph had shown this. On questioning the patient it was learned that these masses had been passed by the bowel, and were found to be partially disintegrated salol tablets.

Another source of error is the presence of phleboliths in the veins of the pelvis. In only one instance have I found evidence in the skiagraph alone to prove that shadows along the lines of the ureters were due to phleboliths and not to calculi. This was in a radiograph made a short time ago of a patient with pain in the lumbo-sacral region afterwards found to be due to locomotor ataxia. An advanced degree of arterio-sclerosis was present, and decided shadows of the iliac arteries could be seen on the plate. The small shadows in question were directly along the side of the arteries in the lines of the veins.

Dr. Joseph F. Smith, Chicago: There is another source of error that may obtain in many cases as was demonstrated recently when I took the trouble to examine the negatives of one hundred pelves taken at random from our collection. In the region of the lower end of the ureter there were numerous small round shadows which might easily be mistaken for calculi. Any one who has a large collection of pelvis negatives will find that these shadows occur in at least 25 per cent. of the cases. We found that twenty-four of these one hundred negatives contained from one to six small round shadows, sometimes on one side and sometimes on both sides, in the vicinity of the spine of the ischium, sometimes above and sometimes below. They are usually

about the size of a pea and are quite dense. In looking up the literature on the subject, and on making careful dissections of cadavers, we found that these shadows are caused by small bony deposits that occur in the pelvic ligaments, especially in those attached to the spinous process of the ischium, so that this is a well defined source of error in diagnosing stones in the ureter.

DR. HENRY HULST, Grand Rapids, Mich.: I am very glad that Dr. Smith pointed out this source of error. If you get a good picture of the pelvis you are likely to bring out shadows that would lead you to believe that stones are present when they are not. These phleboliths must not be mistaken for ureter stones.

Another source of error I could only eliminate by taking a stereoscopic picture of the parts. In one case I found a shadow which puzzled me for sometime until I learned from the patient that she had had a fall sometime previously. As a result one of the transverse processes of a lumbar vertebra had been broken off. It was this fragment of transverse process that gave the shadow which resembled stone, until examined stereoscopically.

DR. M. K. KASSABIAN, Philadelphia: As another source of error I want to mention the shadows made by calcified lymph glands around the lower portion of the ureter. I was told of a case where a scar in the capsule of the kidney showed a dense shadow that was mistaken for stone.

Often it is quite difficult to say whether the stone is in the lower part of the ureter or in the bladder, and this is a very important point to establish as character of the operation differs in each case. To overcome this difficulty I inflate the bladder slightly with air and a skiagraph then taken shows the outline of the bladder clear and aids in locating the stone. Instead of air we can also use water which throws a darker shadow of the bladder which shadow often suffers obliteration whereas if the stone be in the ureter the shadow will be quite apparent.

DR. CHARLES LESTER LEONARD, Philadelphia: Possibly some of our men are getting too good technic and too good details. I think they would be greatly benefited if they would ex-

tend that detail in one plate from the symphysis pubes to the last dorsal vertebrae. The question whether the shadow is a stone, a phlebolith or an ossification in a ligament can be solved by making a plate which will show the outline of the kidney. There is always a passive dilatation of the kidney when there is a stone in the ureter, and when you get that, you can locate the stone definitely.

I had one case where it was difficult to determine whether it was a stone in the ureter or a phlebolith. Some four or five years ago I made the error of diagnosing a phlebolith as a stone in the ureter, but whenever you can get the shadow of the distended kidney on the side on which the stone is located, you can be certain of your diagnosis.

I have had forty-two cases of ureteral stone proved by operation and removal of the stone or by its passage and recovery. I have twenty-eight patients who passed the stone without operation, simply because of the accurate knowledge that the stone was small enough to pass. The period of time for the passage of the stone varied from three days to six months.

Dr. Hulst's technic is so good that he ought to be able to get results without using a diaphragm. This is my objection to the diaphragm; it is too localizing. The compression diaphragm localizes the field too much, so that you cannot see whether or not the kidney is enlarged on the side on which the stone is located.

The matter of technic in the diagnosis of stone is one in which the whole X-ray world is at variance. You find those who support the low vacuum tube. I do because I have had good results with it, and I am afraid to change my technic for fear of increasing my percentage of errors. Dr. Boggs said that the vagabond rays coming from a tube under high pressure are fewer than those coming from a tube energized by a small coil. I have looked on the vagabond ray and the reversal of currents through tubes as a great objection to high voltage technic. When we can overcome that, I will favor using 110 volts as much as any one else, but until I see tubes that will run as smoothly and clearly on the 110 volt circuit, as they do on low voltage, I will

stick to the other. I must see some way to cut out the vagabond ray before adopting discharges produced with the current derived from the main.

Mr. Reid, of King's Hospital, London, uses the ordinary air cushion, or one similar to it, placing it under the abdomen with the patient lying on the face. Thus the weight of the body is used to compress the abdomen and prevent motion. The current is turned on only during certain phases of respiration. In that way, by both a method of compression, and by taking only one phase of respiration, he gets very distinct and clear pictures. Up to the present time he has not had some of the errors that we have had. His errors do not exceed one per cent., but he has not had the extensive experience that some of us have had. The number of calculi he has found is somewhere under fifty. It is a method which needs careful study and consideration.

Dr. Geo. E. Pfahler, Philadelphia: I believe that it may be accepted as true that the man who has not made any mistakes in diagnosis has had little experience. I have made mistakes, like all of you, and the matter of diagnosis of calculi in the lower ureter has been my most difficult problem to solve. In a number of cases calculi were passed, thus proving my diagnosis to be correct.

As to Dr. Leonard's objection to the use of the diaphragm, I raised the same objection a year ago when Dr. Hulst presented this question to us. I did so because I was not familiar with the subject and because of the cumbersome apparatus that seemed to be necessary to carry out his technic. As a matter of fact, all you need is a diaphragm of lead with an opening through which the light passes. How you get that is not so essential, but you do not need cumbersome apparatus to do it.

The technic of Mr. Reid corresponds exactly to the diaphragm compression technic, only he compresses from below upward instead of compressing from above downward. This cuts down the diaphragm which gives him a greater amount of detail. Whether you turn the patient on his face and put a pillow under him, or whether you turn him on his back and put the

plate under him does not make much difference. The problem of catching the vagabond rays or of excluding them is solved when we use the diaphragm.

I also differ with the statement that we can get too much detail. The more detail we get the more positive we can be in our diagnosis.

As to getting the shape of the kidney. In thin people and in children we can get the shadow of the outline of the kidney, but those of you who have had experience know that many of these kidney cases are stout people, who will make you wonder whether you will get a good plate and in these cases you cannot get the kidney outline. I do get the outline of the psoas muscle and of the skin and vertebra, and when I get these, I feel that I have about all I can expect, and while I may have to take a few chances on the diagnosis, I feel that that is the best I can do in that particular case; but I do not say that I must get the outline of the kidney in order to make a diagnosis of stone in the ureter. Physicians expect me to do that but I do not always succeed.

DR. PRICE, Scranton, Pa.: I would like to have Dr. Boggs tell us whether he can differentiate between calculus, gumma, tubercular deposits and pus in the kidney.

DR. GEO. C. JOHNSTON, Pittsburg: I have had the privilege of studying a large number of Dr. Boggs' plates, and he certainly has made some very beautiful plates, but he has not told you everything about his technic. To learn that you would have to watch him closely. He varies his technic from time to time in accordance with what he has in hand, for every patient. He sizes up every patient before he rays for stone. He estimates how much he weighs and what his probable resistance to the ray is. I have been unable to duplicate many of his results. But I have learned many things in calculus diagnosis from Dr. Boggs, and I want to take this occasion of making public acknowledgment of that fact.

I have had some experience with these small bodies that lead us to suspect a stone in the ureter. I remember one plate in particular which I used to view with a great deal of pride. It showed six stones in the ureter. These six stones were arranged

along a line drawn from the kidney down to the entrance of the ureter into the bladder. Not one of these stones was out of alignment. I showed them to the surgeon and we patiently waited for them to be passed, but not one has passed as yet. They are still there as the radiograph showed them.

The subject of the diagnosis of gallstones does not, of course, come under the discussion, but I trust that sometime in the near future we will have the opportunity to hear Dr. Boggs speak on that subject, because he has been doing much work along that line with good result.

I had one case of kidney stone that presented some interesting features. The patient, a man, 35 years of age, was greatly deformed, due to the fact that he had been accustomed to press his side against a work bench ever since he was 14, to relieve the pain of attacks of renal colic. He complained bitterly of pain. He had been operated on for stone but no stone was found. His physician sent him to me and I made a picture which showed quite a large stone in the same kidney which had been operated on. The surgeon operated again and removed a calculus about half an inch in diameter. The surgeon who had operated on him previously was much chagrined, but he was one of those men who do not believe that the diagnosis of calculus by the X-ray is of any value.

Dr. Sinclair Tousey, New York: In regard to the possibility of the stone being on the side opposite to the one in which it is located by the symptoms, I have had one or two of these cases, and since then I have made a routine practice of putting a mark on the plate so that if the radiograph shows the stone on the opposite side, the surgeon will not accuse me of having the film wrong side up.

Quite recently I had a case in which the question of differentiation of a stone in the bladder or ureter came up. The patient, a man, had been suffering from bladder trouble for five or six years, supposed to be due to prostatic obstruction. He was operated on by the Bottini galvanocautery, but failed to get any relief, except from washing out his bladder five or six times a day. I radiographed him and the plate showed a perfectly round spot somewhat larger than a silver dollar in the region of the

termination of the right ureter, and a smaller spot in the region of the left ureter. The question arose whether these were in the ureter or in the bladder. An operation was performed when it was found that these were two masses of the consistency of putty, which explained why they could not be felt at the time of operation or by the stone searchers.

DR. LEAVITT E. CUSTER, Dayton, O.: I always aim to verify my technic by placing a small stone on the surface of the body. If this shows fairly well, then the stone within the body should show better.

DR. CHARLES LESTER LEONARD, Philadelphia: I wish to correct a misunderstanding which may have arisen, that I believe that too much technic is not of value. That is not what I meant. An improved technic necessitates careful interpretation of the negative, and more careful study in determining what the increased detail really shows.

DR. A. L. GRAY, Richmond, Va.: I wish to emphasize the importance of taking a radiograph of every case of suspected kidney stone. One case, a child 8 years of age, impressed on me very forcibly the advisability of such a procedure. A diagnosis had been made of stone in the right kidney by Dr. J. Allison Hodges, which was confirmed by Dr. Geo. Ben Johnston. I made a radiograph and to my great surprise found that the stone, instead of being in the right kidney, to which all the symptoms had been referred, was really situated in the left kidney. An operation was performed and my findings were verified. The stone weighed eighty-six grains.

DR. BOGGS, closing the discussion: I always have my patients clear out their bowels thoroughly before I radiograph them, and I do not allow them to take any fluids for a certain length of time before the examination. The length of the exposure depends on the amount of current going through the tube and the size of the patient. I always place the tube twenty inches from the plate. I do that so as to become familiar with the exposure and so as to have everything as nearly uniform as

possible. For instance, given a patient weighing 150 pounds, I place the tube twenty inches from the surface, exposing for thirty seconds, the energy being from eight to ten milliamperes.

I use the following developing solution: Metol, 3 drams; glycin, 3 drams; dry sodium sulphite, 1½ ounces; potassium carbonate, 3 ounces; potassium bromid, 1 dram, and water, two quarts.

I have been very fortunate not to have had more mistakes. Of course, there are some cases that have not been operated on, but two-thirds of the cases I have examined have been operated on or the stone was passed. I think that we ought to study our cases more carefully. For instance, in one case, when I first examined the plate, I made a diagnosis of calculus in the right kidney. After studying the plate again and looking the case over more thoroughly, I thought it might be a case of tuberculosis of the kidney. Then I examined the sputum and found tubercle bacilli. Undoubtedly the shadows I found were calcified tubercular deposits.

Results of X-Ray Treatment of Leukemia.

BY JOSEPH F. SMITH, M.D., CHICAGO,
and
JOSEPH A. CAPPS, M.D., CHICAGO.

The observations recorded in this paper apply entirely to the lymphatic variety of leukemia. Several cases of the myelogenic type have been under observation but it has seemed best, on account of our good fortune in having a considerable number of lymphatic cases for study, that we should confine this paper entirely to this variety of the disease.

GENERAL CONDITIONS.

The effects of X-rays upon all cases of the chronic type in which treatment has been conducted for a period sufficiently long have been quite constant. No case has failed to respond in a greater or less degree and the nature of the response has been practically the same in all cases, i. e., a fall in the white count due to a diminuation in the number of mononeuclear cells and a decrease in the size of the spleen and glands.

The constancy of these effects have led to the conclusion that the action of the X-rays in whatever way brought about is in a certain sense specific or selective in its action upon the cells of the blood and of the tissues affecting particularly as the charts show the mononeuclear elements in the circulating blood and the lymphoid cells of the fixed tissue elements. These results are also in accord with the work of Heinecke, who found the lymphoid tissue most affected in his experiments upon animals.

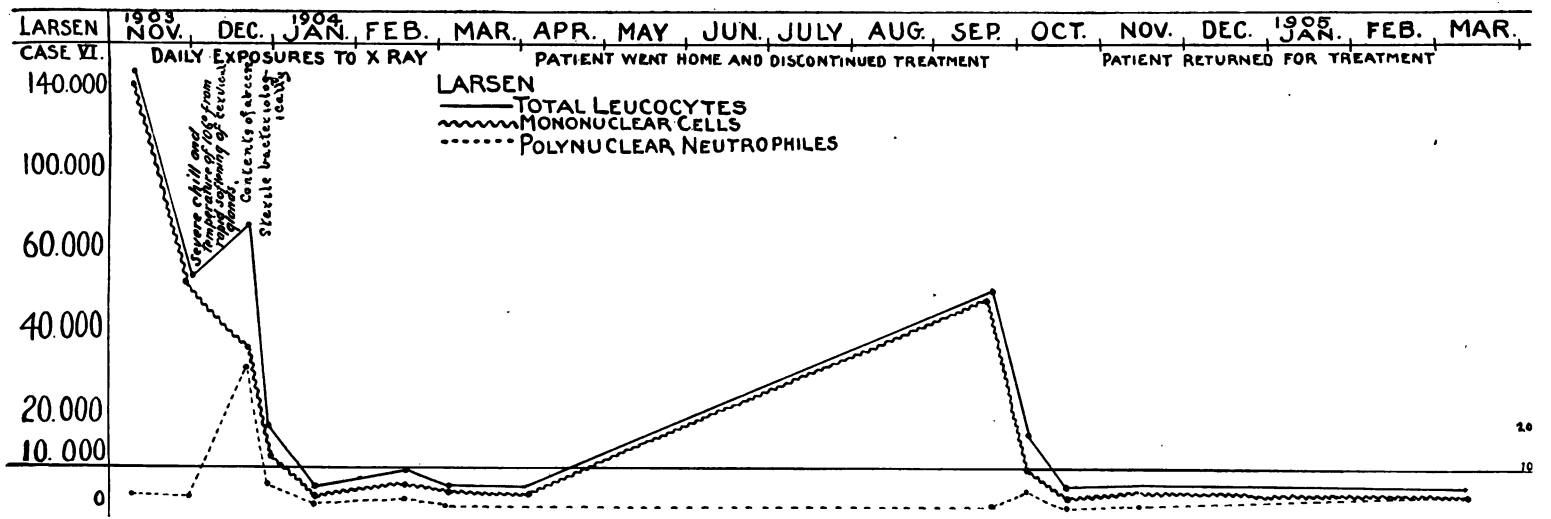
Two explanations for this action suggest themselves: (a) That the action is in reality a direct action upon the blood itself with the development of a leucotoxin, which, circulating in the

blood, produces the widespread effects upon the blood and lymphoid tissues or (b) that the action is primarily upon the fixed tissue cells in the regions exposed, and that some change in these cells sets free a leucotoxin which affects the cells in the circulating blood. Our attempts to ascertain whether or not the action upon the blood can be brought about by direct exposure of blood outside the body have not up to this time been satisfactory on account of the difficulty of attaining a sufficiently large quantity of blood from any one patient at one time to give decided results. We have, however, been able by injecting the blood serum of leukemic patients who have responded to the X-ray into animals to produce in these animals a decided drop in the total leucocyte count and to show by differential counts that this drop is due to a diminution in the mononeuclear elements. It seems therefore that the blood serum of patients who have responded to X-rays contains a substance which is toxic for the leucocytes of animals and has furthermore a specific action upon a certain group of cells, namely, the mononeuclear elements. We have furthermore been able to demonstrate in fresh hanging drop preparations that the serum of leukemic patients who have responded to X-rays has a decided power of clumping and destroying the leucocytes of normal individuals and of other leukemic patients and that this action is specific for the mononeuclear elements. Much work needs to be done before detailed statements of the action can be made, but we have accumulated a mass of data which with further work still under way will furnish material for a later and more detailed report.

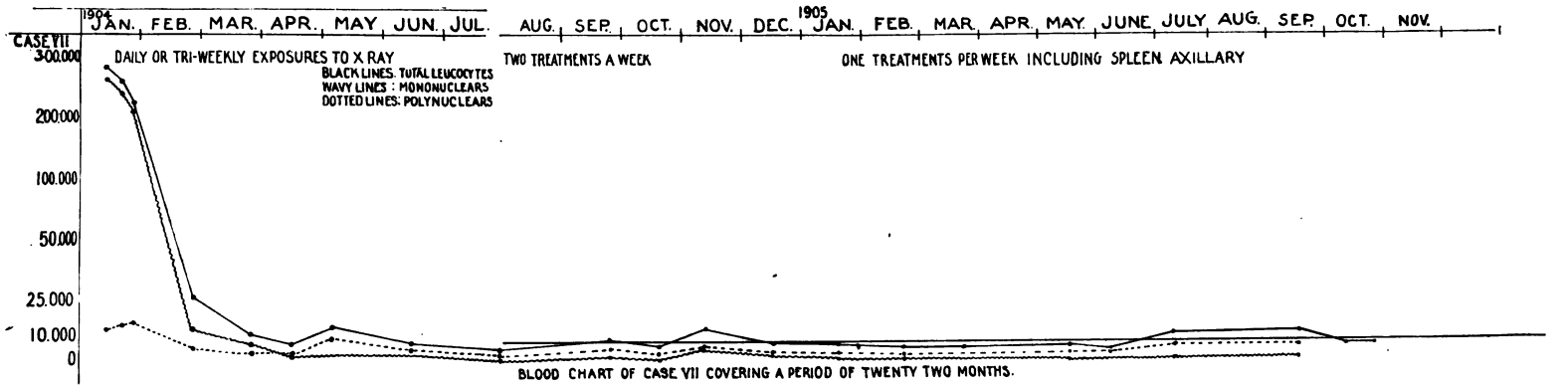
TECHNIQUE OF THE X-RAY EXPOSURES.

The exposures were given in some instances daily and in others every other day. Medium or hard tubes were used at a distance of 8 to 10 inches from the anode to the skin and exposures of three to five minutes made over the glands of the neck, axilla and groin, and also over the spleen. Sufficient current was passed through the tube to give a distinct greenish hue to the tube without heating the anode to redness.

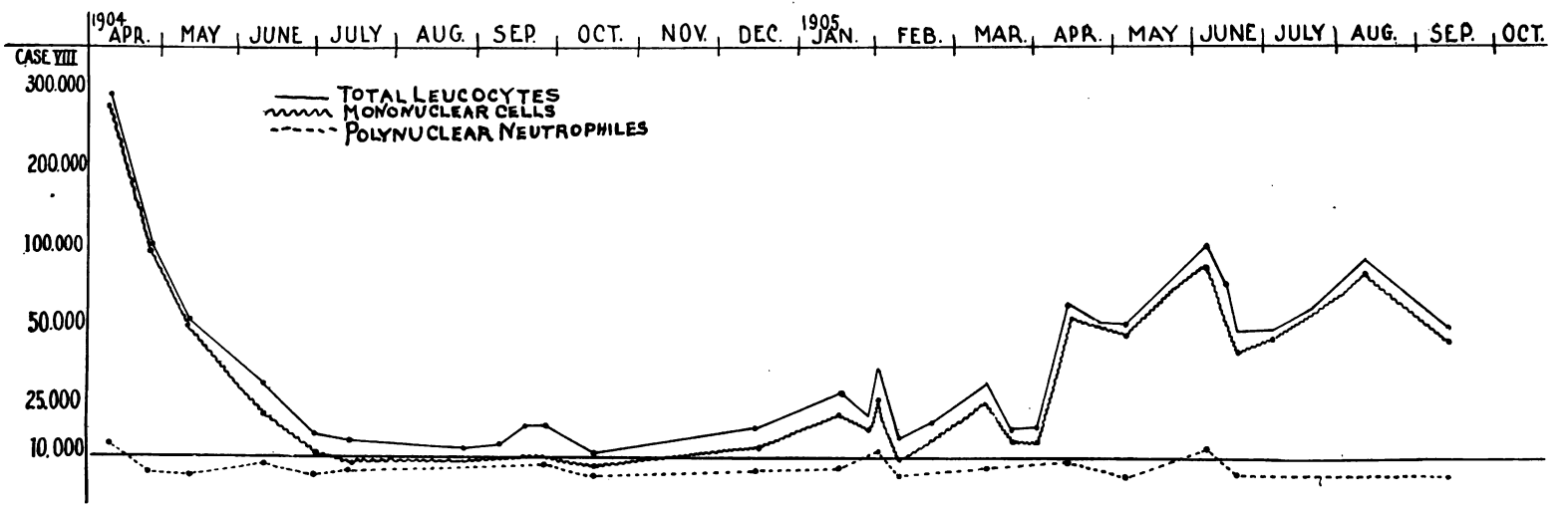
The results of the treatment locally upon the glands are well shown by the photographs of cases VI and XII and upon



Blood Chart of Case VI.



Blood Chart of Case VII.



Blood Chart of Case VIII.

the blood by the differential charts of case VI and VII. The chart of case VIII is interesting in that it shows the blood of a patient unusually resistant to X-ray treatment. There was a

Table showing duration of disease and results of treatment in twelve cases of Lymphatic Leukemia.

Case		Type	Acute or Chronic	Effect of X-Rays Upon			Probable Duration of Disease	Time of Observation under X-Ray	Present Condition
				Spleen	Glands	Leucocytes			
I	Bennetts	L	Acute	None	None	None	1 Mo.	6 Days	Death
II	Grinnell	L	Acute	None	None	69,000 to 299,000	Unknown	10 Days	Death
III	Loeb	L	Acute	Slight	None	12,000 to 3,000	Unknown	7 Weeks	Death
IV	Bresseau	L	Subacute	None	None	80,000 to 64,000	4½ Mos.	6 Weeks	Death
V	Cohl	L	Subacute	Much reduced	Reduced to nearly normal Size	70,500 to 25,000	12 Mos.	10 Mos.	Dead
VI	Larson	L	Chron.	Reduced to nearly Normal	Reduced to nearly normal	295,000 to 6,800	2½ Years	18 Mos.	Death same month after leaving hospital. Reported cause —phthisis
VII	Fifield	L	Chron.	Reduced to nearly Normal	Reduced to nearly normal	150,000 to 4,200	26 Mos.	20 Mos.	Living in good condition
VIII	Knox	L	Chron.	Greatly reduced	Much reduced	300,000 to 12,000	2½ Years	17 Mos.	Living Greatly improved. (Recent relapse)
IX	Kempthorn	L	Chron.	Much reduced	Much reduced	145,000 to 6,000	14 Mos.	10 Mos.	Living. Much improved
X	Newberger	L	Chron.	Much reduced	None present	164,000 to 16,000	15 Mos.?	3 Mos.	Living. Much improved
XI	Rich	L	Chron.	Slightly reduced	Slight decrease	350,000		3 Weeks	Slightly improved. Lost track of patient
XII	Floyd	L	Chron.	Much reduced	Markedly reduced	210,000 to 25,000	14 Mos.	6 Weeks	Died; reported cause pneumonia

rather rapid fall in the count at first, but the blood at no time reached normal. Since that time the blood responds less readily to treatment and the disease rapidly reasserts itself upon the cessation of treatment although the patient's general condition is better than when he began treatment. The detailed results of the treatment are shown in the large table:

CONCLUSIONS.

1. The action of X-rays seems to be of two kinds. (a) A local action on glands and spleen characterized by a breaking down and disintegration of the lymphoid tissue. (b) The manufacture of toxins have a selective action upon the mononeuclear elements of the blood.

2. In no case has there been any benefit from the use of X-rays in acute cases of leukemia.

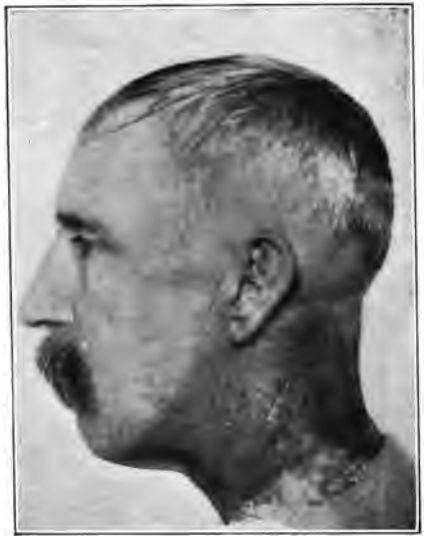
3. With the discontinuance of the X-ray the disease after a longer or shorter period of time tends to reassert itself.

4. Death may take place when the blood count is normal and the spleen and glands are smallest.

5. The X-ray holds the disease in abeyance, but probably is not curative. It is yet too soon to say that persistent treatment of favorable cases may not give permanent relief. In any event there can be no doubt that the intelligent, persistent use of X-rays offers more hope of relief to these patients than any and all other methods of treatment combined and that X-rays will have a permanent place in the therapy of this serious disease.

(The discussion on this paper will be found on page 182.)

Case XII at time of beginning treatment.



Case XII after six weeks treatment.

The X-Ray Treatment of Leukaemia and Other Diseases of the Blood-Making Organs

BY HENRY K. PANCOAST, M.D.,
Of Philadelphia.

Previous to the discovery of the value of the x-ray as a therapeutic agent, certain disease conditions referable to the blood and blood-making organs, especially Leukaemia and Hodgkin's disease, were regarded as diseases for which there was no drug that could be claimed to act as a "specific." Arsenic was probably the most reliable remedial agent which seemed to have much value in combating them, but real cures were infrequent, and the action of this drug was uncertain and variable. It is particularly with Leukaemia that we wish to deal in this paper, and it is certainly of great interest to us, as well as to the medical profession at large, to know that the x-ray has been found to have by far the greatest value of any therapeutic agent yet discovered in its action against this disease. On account of the large and steadily increasing numbers of the earlier cases reported as "cured" under x-ray treatment, we were all led to believe that a reliable specific therapeutic agent had been found. Little was known of the action of the rays upon the tissues concerned, and the possibility of relapses was given but slight attention. The wonderful results obtained seemed almost as remarkable, if not more so, than those accomplished in the treatment of superficial cancers and lupus. It was surely justifiable to regard this new method of treatment as a "specific," but as later reports have begun to show an exceeding frequency of relapses, that ultimate death often follows a supposed cure, and that there are certain serious dangers attending an indis-

criminate use of x-rays, conservative men are beginning to look upon the Roentgen specialist as over-enthusiastic in his claims, and perhaps with some justice; but at the same time, these very men are perfectly willing to acknowledge that the x-ray has great value, and is the most reliable agent in treating Leukaemia, and do not hesitate to submit all such cases to this form of treatment.

Recent investigations in regard to the effect of x-rays upon the metabolic processes, and especially as to their action upon lymphatic tissue and bone marrow, have somewhat additionally justified a conservative feeling, and at the same time have added renewed interest to the subject of x-rays and radio-activity. These researches would seem to have led us almost if not quite up to the brink of the discovery of the real action of this form of energy upon cell life and metabolism and the ultimate factor in its curative and its destructive powers.

I am indebted to Dr. John H. Musser for the privilege of reporting two cases of spleno-medullary Leukaemia referred by him for treatment in the x-ray laboratory of the hospital of the University of Pennsylvania. I am also indebted to Dr. David L. Edsall for notes on the experiments* in metabolism carried out in these two cases particularly, and in some others to be referred to in conjunction. Brief notes of the history and treatment of these patients follow:

Case 1. E. C. H., male. white, 44 years, plumber, married. Admitted to the University Hospital 9-15, 1904. The family history and previous personal history have no bearing on the case. During March, 1904, six months before admission, he began to notice a loss of strength, which was gradually progressive. Mental irritability and occasional attacks of diarrhoea were the only other symptoms noted up to the

*A full report of these experiments was made in a joint paper by Dr. Musser and Dr. Edsall, read at the meeting of the Association of American Physicians, Washington, D. C., May 16 and 17, 1905. The article will appear in print later in "The University of Pennsylvania Medical Bulletin."

date of admission. The important points brought out in the examination at that time were as follows:

Weight, 168½ pounds.

Measurement of spleen, on the anterior axillary line, from the 7th rib above to 3 inches below the level of the umbilicus. Anteriorly it extended nearly to the median line. The greatest length was 12½ inches, and the greatest breadth 13 inches.

The liver was not enlarged.

The inguinal and axillary lymphatic glands were palpable, but not enlarged to any extent.

Blood examination:

Haemoglobin	38 per cent.
Red cells	4,280,000.
Leucocytes	407,500.

The differential count one week later was as follows:

Myelocytes	49.2 per cent.
Polymorphonuclears	27.1 per cent.
Transitionals	21.6 per cent.
Eosinophiles	1.0 per cent.
Lymphocytes	0.2 per cent.
Nucleated reds	0.8 per cent.

X-ray treatment was started September 5, 1904, and until October 24th the applications were made almost daily, making 37 during that time. These exposures were made over the entire abdomen and most of the thorax, with the tube usually over the splenic area, but its position was changed from time to time as any signs of dermatitis appeared. The arms were occasionally included. A rather hard tube was used, with a resistance equal to 3 to 4 inches of spark gap, and the anode was placed from 12 to 16 inches from the surface of the body. A current of 2 to 2½ milliamperes in the secondary was furnished by an 18-inch coil and electrolytic interrupter. The first exposures lasted 3 minutes and this time was later increased to 6 and 8 minutes. The lower extremities were exposed for 3 minutes in addition at each treatment. After 25 applications the patient had improved sufficiently to return home (October 12th). At that time the leucocyte count was 138,000 and the spleen had decreased greatly in size. He returned daily for his

treatments until 37 had been given. A very marked erythema appeared over the entire abdomen at this time, and for this reason and on account of the improvement in his condition, the exposures were continued four times a week. The leucocyte count was then 37,000. While the dermatitis lasted the applications were made to the left side and back. At the end of 52 treatments (November 26th) the spleen was scarcely palpable, and the leucocyte count was normal. The exposures were then continued once a week until February 15th, 1905, at which time 66 applications had been made, over a period of 21½ weeks. Then the spleen was not palpable, the leucocyte count was 6800, and the patient weighed 180¼ pounds, a gain of 12 pounds. He had also recovered his strength, and was able to attend to his work. He was considered cured, but was told to come back in 10 days, as it was thought advisable to make an occasional exposure as a preventive measure against recurrence. He did return in 10 days (February 25th) and complained of not feeling well, and said he ached all over, as though he had taken cold. The spleen was found to extend 1½ inches below the costal margin on deep inspiration, but could be pushed up under the ribs during expiration. The leucocyte count was about 80,000. Active treatment was at once started, and three exposures of 10 minutes each to the thorax and abdomen and 3 minutes to the lower extremities were made each week. In spite of this, he grew progressively worse and was admitted to the hospital for the second time March 12th, 1905. He was then having chills, and running a temperature as high as 101°; the spleen was considerably larger, and he felt very weak. The leucocytes numbered 180,400, and the differential count made by Dr. Kelly was as follows:

Basophiles	4.0 per cent.
Lymphocytes	4.0 per cent.
Polymorphonuclears	18.0 per cent.
Eosinophilic myelocytes	2.5 per cent.
Neutrophilic myelocytes	71.5 per cent.

After admission, three daily treatments were given, and then from March 14th to 23rd exposures were stopped because it was feared that the x-rays might be doing harm.

Metabolism investigations were started during this interval. The patient rapidly became worse, was very much prostrated, fever continued high, retinal hemorrhages occurred, the spleen became larger and the leucocytosis rapidly increased. From March 23rd to 30th daily exposures were made, but the patient did not respond to them. On the 29th the leucocytosis had increased to 496.000, and he died suddenly April 1st. Unfortunately no autopsy was allowed.

This case is interesting from many points of view. After making 66 x-ray exposures during a period of 21½ weeks, the patient was thought to be cured, but during a short period of ten days he developed symptoms of an acute relapse, and died five weeks later, despite x-ray treatment. The metabolism investigations made during this relapse will be mentioned later, in connection with the second case.

Case 2. Mrs. L., white, 42 years, married. Admitted to the University Hospital March 20, 1905. The family history and previous personal history have no bearing on the case. The first symptoms of the present disease were manifest about October, 1903, 18 months previous to admission, when she noticed that she tired easily, lost weight, and her skin took on a "greenish hue." Later there followed a sensation of fulness, accompanied by pain and tenderness over the splenic area, and a palpable mass was easily felt below the ribs. She was treated medicinally and improved, and in the spring of 1904 she had gained 30 pounds in weight and felt perfectly well. She was then regarded as cured. Her good health was maintained until October, when a relapse occurred, one year after the beginning of the first attack. She dates this recurrence from a severe hemorrhage lasting nine hours following the removal of a small cyst from an eyelid. Though the incision was small, she lost sufficient blood to cause a mild shock. Whether this was the starting point or not, the spleen began to enlarge almost immediately, and there followed an onset of the same general symptoms that were present in the attack one year previous. All the symptoms became slowly but progressively worse up to the time

of her admission to the hospital, March 20th, 1905. The important points brought out in the examination at that time were as follows:

Measurement of the spleen, on the anterior axillary line, from the seventh interspace above to within one inch of Poupart's ligament below. Anteriorly it extended one inch beyond the median line. The surface was smooth and the right border notched below the costal margin. There was tenderness along the right border. The superficial lymphatic glands showed no enlargement.

The liver was not enlarged.

Blood examination:

Haemoglobin	68 per cent.
Red cells	3,410,000.
Leucocytes	245,000.

The differential count made by Dr. Kelly was as follows:

Neutrophilic myelocytes	45.0 per cent.
Basophilic myelocytes	16.0 per cent.
Eosinophilic myelocytes	3.0 per cent.
Polymorphonuclears	26.0 per cent.
Lymphocytes	9.0 per cent.

The urine showed a trace of albumen and some casts.

The patient was pale, weak and emaciated.

X-ray treatment was started March 26th, 1905, when the leucocytosis was 304.400. From the start the treatment was pushed more vigorously than in the first case, and exposures were made daily until April 20th, 26 applications being given in this time. The abdomen and lower two-thirds of the thorax, and occasionally the arms, were exposed, but the pelvis was protected, as is advisable when possible in treating a female. The tube was usually placed over the splenic area or epigastrium, with the anode 12 to 14 inches from the surface of the body. The exposures were from 8 to 10 minutes each, and from a Muller, Gundelach or Swett and Lewis tube having a spark gap resistance of from 3 to 4 inches, and excited by a current of 2 to 3 milliamperes in the secondary generated by a 24-inch coil and electrolytic interrupter. The lower extremities were also separately exposed for 3 minutes at each sitting, with the tube in the neighbor-

hood of the knees. This patient was exceedingly anxious to leave the hospital and return to her home as soon as possible. Her skin seemed to be not at all susceptible to x-rays. Because of these two facts and because the progress of the case was rapidly favorable, I pushed the treatment vigorously. A slight bronzing of the skin of the abdomen appeared after 8 exposures, but there was nothing worse than this until after 26 had been made. Then the skin of the whole abdomen became very red suddenly, and a burn of the second degree developed within 3 days. Part of the area about the size of a hand became worse and later showed the appearance of a third degree burn, while the surrounding skin healed. This ulcerated area is just about healing now, five months later.

After the 26th treatment, the patient was well enough to leave the hospital, April 20th. The leucocytosis had then decreased to 15.360, and the spleen extended to a short distance below the level of the umbilicus, and exteriorly to 1½ inches to the left of the median line. The following table shows the progressive reduction in the leucocytosis:

March 20, on admission	245,000
March 23, metabolism experiments started	272,000
March 24	249,000
March 25	276,000
March 26, x-ray treatment started	302,400
March 27	262,400
March 28	252,400
March 29	246,400
March 30	214,400
March 31	191,200
April 1	149,600
April 4	96,000
April 5	80,080
April 7	40,080
April 9	32,800
April 11	30,400
April 13	24,720
April 15	28,440
April 17	17,440
April 18	15,200
April 20	15,360
April 26	12,480
April 30	6,480
May 8	9,040

From April 20th until May 3rd (2 weeks) only 5 treatments were given, because of the dermatitis and general improvement, and these applications were made to the left side and back. She returned to her home May 10th and the leucocytes then numbered 6080 and the spleen was still smaller. The blood count was as follows:

Haemoglobin	85 per cent.
Red cells	5,220,000.
Leucocytes	6,080.

After April 15th the urine was normal.

Realizing the experience of most men, and because our first patient died during an acute relapse, and because this second patient was being treated for a recurrence, she was advised to have an occasional x-ray application through the summer, and to have several close together in September—this present month—as both the primary attack and the recurrence had started about this time of the year. The last report received from her, about two months ago, stated that she was feeling very well and was gaining weight, but that she still had the burn.

In addition to the reports of the facts of importance in these two cases, I wish to bring out in this paper the value of a careful study of the effects of x-ray exposures upon the process of metabolism, particularly in connection with the treatment of the disease under discussion, and to emphasize the necessity of exercising the utmost care in treating each case of this kind. Dr. Edsall made a careful study of the effects of x-ray treatment upon the process of metabolism and tissue destruction in each of these cases, and he has kindly permitted me to add here an abstract of his investigations.

The experiments of Heineke have shown that the effect of prolonged x-ray exposure upon animals is manifest only in the lymphatic tissues of the body and in the bone marrow, with complete destruction of the lymphoid structures early, and before any very marked symptoms arise. The reduction in size of the spleen and lymph glands and disappearance of white blood cells in cases of leukaemia under x-ray treatment

are in accordance with the results of these experiments. It is to be supposed that the tissue destruction occurring in leukaemic cases under this form of treatment is limited to the lymphatic structures, and perhaps to the bone marrow in addition. Tissue destruction does take place undoubtedly, as experiments have shown, and with such great rapidity that the individual could certainly not show signs of improvement or recover were the other normal structures of the body affected much, if any, by the rays. The results of x-ray action upon leukaemic tissue are certainly not the same as those observed in the structures of the surface of the body in the x-ray burn, or in the epithelioma breaking down or healing under treatment.

There is a marked contrast in the effects of the applications upon the process of metabolism in these two cases, as is shown by Dr. Edsall's investigations. For a period prior to the beginning of x-ray treatment, both patients were placed upon a carefully measured diet of milk, bread, butter, eggs, sugar, rice, steak and baked potatoes. The amount of nitrogen and P_2O_5 taken in at each meal had been estimated at as nearly accurate a figure as is possible, and we may assume it to have been correct, without going into the details. During the control period prior to, and for three days following x-ray treatment in each case the nitrogen, P_2O_5, uric acid and purin bases in the urine, and the nitrogen and P_2O_5 in the feces were estimated daily. It was not advisable to adhere to the rigid diet longer than these periods on account of the conditions of the patients.

In the first patient, who showed at the time the signs of a profound toxemia during an acute relapse, and who was rapidly becoming worse, there were no evidences of an excessive general tissue destruction after x-ray exposures, as shown by comparison of the results then obtained with those of the preliminary control period. The results were similar under the later regular diet. The tissue destruction was not excessive either before or after beginning treatment, and we may therefore assume that this severe and acute toxemia was

not necessarily due to such a cause, as is often the case in certain severe stages of leukaemia. As there were no evidences of nephritis we may assume that there was no interference with or incompetency of kidney function. During the three days in which x-ray treatment was resumed and the investigations were carefully made under restricted diet, it was found that the applications had practically no appreciable effect upon metabolism and tissue destruction, which were scarcely at all excessive. Therefore in a case in which x-ray treatment was having no effect, and which was rapidly growing worse, tissue destruction was not increased by the treatment, but as death approached, it seemed really to grow less.

In the second case which apparently was "cured," the experimental results were in marked contrast to those in the first patient who died. There were also in this case, as in the first, no evidences of abnormal tissue destruction revealed during the preliminary control period prior to treatment, but on the other hand, a retention or loss of products, as in the first. This had probably some conection with the disease. After the control period of three days, x-ray exposures were started, with the patient on the same restricted diet. There was at once a marked increase in the elimination of products denoting a similar increase in tissue destruction, and this was made manifest with remarkable rapidity during this time. It will be noted that there was a decided corresponding decrease in the leucocytosis accompanying these changes. The increases in the daily average excretions in the urine compared to the period previous to treatment may be stated roughly as follows:

Nitrogen	70 per cent.
Uric acid	60 per cent.
Purin bases	260 per cent.
Phosphates	200 per cent.

The amount of nitrogen and phosphates in the fecal excretions was practically unchanged, or not altered sufficiently for consideration. Dr. Edsall concludes that the increase in tissue destruction during this period was more than 100 per cent. Accurate figures could not be determined subse-

quently, after resumption of ordinary diet, but there is every reason to believe that these percentages continued or were increased.

That the toxemia manifested in this patient was not due to tissue destruction may be proven by the fact that as the destruction was greatly increased the patient became better and the toxemia disappeared. In the first case it was not due to this cause, as the destruction was not at any time excessive. Leukaemic tissue may be responsible for the toxemia, however, either by the elaboration of toxins, or by their production during the process of building up of the excessive amount of tissue.

Surely there is no other therapeutic agent capable of producing such rapid and marked destruction without injury to the rest of the economy: and moreover, there is certainly none known that will cause such destruction with an improvement in symptoms at the same time. Tissue destruction is undoubtedly the greatest factor in the results accomplished by the x-ray treatment of leukaemia. Whether it be the only factor or not, we do not at present know. It is probable that the action is not direct, but that the x-rays exert their influence upon autolysis. The almost immediate effect and the rapidity of destruction would seem to favor this view.

The x-ray has the power of influencing tissue destruction in other conditions as well, but not to the same extent. Dr. Edsall has noted an increase under exposures of cases of gout treated for Dr. Stengel and himself in our laboratories. Also, with the view that an unresolved pneumonia persists because of the absence of the necessary autolytic process required for the destruction of the exudate, he tried x-ray applications in one case, for the purpose of stimulating this process as it does a similar action in leukaemia. His efforts in this case met with apparent success. With such results in view, he acknowledges the possibility of a favorable influence of x-rays upon many nutritional and infectious disease conditions.

Realizing the remarkable influence of x-ray treatment upon leukaemia we must recognize the fact that we are employing not only a very valuable but also a most dangerous therapeutic agent. The very rapid and extensive destruction of lymphatic tissue which we attempt to bring about in dealing with this disease is sufficient evidence for the use of great care in carrying out our treatment. We do not know that this same effect upon lymphoid tissue may not be caused in the normal individual or animal, or in one suffering from some other disease, and we do know that in experiments upon animals, excessive destruction of these tissues from prolonged exposure may result in death. We cannot be absolutely sure that some unfortunate results may not at some time be obtained while applying ordinary treatment without reasonable care. There is sufficient evidence at hand to allow us to place some credence upon the reports of evil results suspected to be due to x-ray exposures, such as extreme prostration, febrile reactions and other manifestations of an apparent intoxication, gastro-intestinal disturbances, and nephritis. Beyond any possibility of doubt, sterility may be induced by x-ray exposure, and our patients, both male and female, should always be protected from any such unfortunate result.

In addition to our two examples of the same disease, in which one patient was benefited and the other not, Edsall has pointed out that in different cases of a condition, one patient may be improved and another made much worse by x-ray treatment. The effect of x-ray exposures was tried on two cases of pernicious anemia under his care. Neither of them had responded to ordinary treatment. A single exposure on the first patient was followed by a violent chill, high fever, prostration, a rapid fall of red cells from 1,200,000 to 600,000, and death a few days later. A second patient who was rapidly growing worse, and who had a red count of 700,000, quickly improved under x-ray applications, and later the count increased to 3,500,000. A relapse one year later was treated in the same way and there was improvement for a while, and in one week there was a gain of 2,000,000 red

cells, but after a certain point, there was no further change. In the first patient there were evidences of an intoxication, but not in the second, and it was concluded that this was the cause of the difference in results, and that possibly the additional tissue destruction due to an x-ray exposure overwhelmed the first patient.

Not only should the toxic condition of a patient be carefully studied in leukaemia and other allied diseases, but the tissue destruction should also be investigated before and after beginning x-ray treatment. We should not otherwise feel at liberty to proceed. Both of these points should be watched and compared, in order to guard against dangers, and to ascertain the results being accomplished. Each case of this kind should be reported in detail, irrespective of the ultimate result, in order that we may all arrive at the proper technique for treatment, and learn better the values and dangers of this therapeutic agent.

It was the intention to include in this paper the reports of one case of Hodgkin's disease and one of polycythaemia still under treatment, but space and time forbid the mention of more than a very few remarks in regard to them. In the case of pseudo-leukaemia, all the superficial lymphatic glands and the spleen were markedly enlarged. Under prolonged x-ray treatment they were very much reduced in size, but whenever the exposures are discontinued for any length of time there is always a tendency for a recurrence of the manifestations.

The case of polycythaemia was referred by Dr. Alfred Stengel and Dr. B. F. Stahl. The red cells numbered about 10,000,000 when treatment was started. While exposures are continued the count varies from 7,000,000 to 9,000,000, but there seems to be no tendency as yet toward a permanent reduction to normal.

DISCUSSION.

Dr. A. L. Gray, Richmond, Va.: These papers have been of great interest to me, especially that by Dr. Smith on account of a personal experience in a case of lymphatic leukemia that I

treated last spring. It was almost identical with Case VI of Dr. Smith's series, except that it was a subacute rather than a chronic case.

The diagnosis of lymphatic leukemia was incontrovertible. The lymphocytes numbered 140,000; the red cells about 1,800,000, hemoglobin 65 per cent. The patient's physical condition was so poor that he was unable to walk across the floor without assistance, nor could he take proper nourishment on account of anorexia and constant nausea. He had a hectic flush, fissures in each nostril, and a fissure in ano, all of which had been treated, but stubbornly resisted attempts to cure.

All medication was stopped, and I began to ray him every other day. My technic was identical with Dr. Smith's except that instead of using the coil I used the plate machine with a spark gap of five inches, treating each group of glands for about five minutes, and the spleen for about the same length of time. The results of one week's treatment astounded me. A blood count was made after the fourth treatment. The lymphocytes then numbered 45,000 and the red cells, 2,000,000, with a hemoglobin percentage of 70. After the second week's treatment the lymphocytes numbered 25,000; in the third week, 16,000; fourth week, 15,000, and fifth week, 10,000. On account of pressing business at his home he left me, promising to return as soon as possible.

He wrote me about two weeks afterwards that the glands all over his body had disappeared almost entirely and that he was feeling perfectly well. The fissures had all healed up. About a month thereafter the man died of what was said to be acute tuberculosis. No postmortem was held nor sputum examination made that I know of. I have my doubts about the diagnosis on account of the probably similar termination from the leukemia.

I also have had referred to me for treatment a couple of cases that have been diagnosed as splenic anemia with a very decided leucopenia. I would like to ask whether any one can give me any information as to the probable results of the treatment.

DR. GEORGE E. PFAHLER, Philadelphia: I am sure we all feel indebted to Dr. Smith for the excellent and thorough investigation he has made of this matter. I have had three cases but I did not investigate them as thoroughly as he did.

I want to add a case of chronic cyanotic polycythemia to Dr. Pancoast's list that came under my observation two years ago. He is still under treatment. The patient was bedfast, and his red cells numbered 11,000,000. The spleen extended into the pelvis, yet to-day he is symptomatically well; that is, he can go about his occupation and he is comfortable. His spleen is greatly reduced in size, but the number of red blood corpuscles has not been influenced in any way.

DR. W. S. NEWCOMET, Philadelphia: I would like to mention a case where the interpretation of the various shadows caused an error in diagnosis. A few months ago a young man was brought to me for examination, with a fairly typical history of acute tuberculosis. Upon examination with the fluoroscope, and also from a plate, the clinical history was confirmed. About a month afterward, meeting the physician who had charge of the case, he told me that a mistake had been made in the diagnosis of his case. It turned out that the man was suffering from acute leukemia and that the nodules in the lung that had been mistaken for tubercles were really enlarged lymph follicles. At the time of examination the spleen was overlooked so that I do not know whether or not it was enlarged.

DR. HENRY HULST, Grand Rapids, Mich.: I wish to report a case of Hodgkins' disease. The patient presented all the typical symptoms of this affection. I treated her twelve times and then she felt so much better that she concluded to go home. That was on Wednesday. Thursday she did not feel quite so well and on Friday she died from acute congestion of the lungs.

DR. SMITH, closing the discussion on his part: In regard to Dr. Gray's cases of splenic anemia, I had an opportunity to see five of these cases, and so far as I have been able to determine the results of the X-ray treatment of this form of splenic enlargement have been entirely negative. One case that I had

under observation for a long time which had been diagnosed as a splenic anemia later developed into a typical splenomyelogenic leukemia. A blood count was sent to me after the patient had gone. The leucocytes numbered three or four hundred thousand with the appearance in the smears of typical myelocytes characteristic of that form of leukemia. When he was in the hospital his blood count was four or five thousand, but no differential count was made.

I wish to call attention to the fact that in the twelve cases I cited there is a considerable amount of satisfaction to be derived from the fact that although the first six cases are dead, at least four of the others are still living and one of the patients is able to go about with all his former vigor. One or two treatments a week have been sufficient to keep his blood count down, so that now, even with a careful examination of the blood, a diagnosis of leukemia would not be made. That has been my most satisfactory case. Two or three others are in good condition, but they have not been under observation so long.

Another thing is apparent; the specific action of the X-ray on the mononuclear cells in the blood. It is also a fact that during the period as shown in the chart, where an abscess developed in the neck of one of the patients, while he had a temperature and other evidences of acute infection, although the contents of the abscess were sterile, the blood count rose and the rise was due to an increase in the polymorphonuclear cells and not in the mononuclear cells.

On the Treatment of Tubercular Lupus

BY G. P. GIRWOOD, M.D.,
Of Montreal, Canada.

When I undertook to give my ideas about the treatment of lupus by the X-rays, I little thought of the work before me. I had really only thought of those cases of lupus which had been treated by myself, but on looking at the index of Crocker on Diseases of the Skin, I find a portion of nearly 400 pages of his work devoted to lupus of one form or another, the mere giving the names of which would alone occupy considerable time.

I will therefore devote myself to the discussion of those cases that have come under my treatment, rather than take up your time with a theory of the treatment of those cases that I have not seen.

On looking over my notes of cases, I have selected the following as typical: Case 1. Miss E. W. Tubercular lupus on both cheeks. Female, age 30, case of 5 years standing; had been treated by scraping and various applications by numerous surgeons, but without any permanent relief, and a general increase to date. Treatment commenced in June, 1901, half a dozen treatments, on alternate days of 5 minutes, small French tube, 110 volts, 7 amperes. Treatment was left off during my absence in Europe till October, during which time considerable improvement took place, and on my return treatment was again continued on alternate days for a week, then stopped for a week, then continued, with constant improvement till the middle of November, then an attack of measles stopped the treatment for six weeks and it was again continued at intervals from January till May, 1902, with a permanent cure, and still remains cured, the scar even gradually improving without further treatment. The skin is glazed where it was scraped and is the only mark remaining.

Case 2. Miss G., age 34, extensive hypertrophic tubercular lupus of 28 years standing, came to me 2 years ago, the condition then was a large thickened condition of the skin, commencing at the inner canthus of right eye along lower lid across the temple, around the ear, down to 2 inches behind angle of the jaw, under the chin, across the neck, up behind the left ear and across towards the left eye, down the middle of cheek to the jaw, over the facial artery, under the chin, across to other side and up past the angle of the mouth to the point of starting. All this extensive area of integument was raised as a copper colored mass of flesh with tubercular nodules projecting and raised above the surrounding surface of from one-half to one inch in thickness. A similar patch of four inches by five inches existed on the scalp of the left side over left eye and extending to the forehead. Another patch on the upper lip on the left side, several similar patches on the right arm, and two on the chest over the third rib and its connection to the sternum, and one about three inches in diameter on the right thigh in front.

The two largest patches on the face were treated with X-rays, the rest being shielded with tea chest lead, two patches on the arm were treated with high frequency current, applied by a Geisler tube. Two more were treated by Lortet & Genauds' modification of Finsen light, and in all cases the thickening of the tissue was very much reduced. Unfortunately this patient had other troubles which prevented her punctual attendance. She would be absent sometimes for months at a time, but improvement still went on. In consequence of the irregularity of the attendance a little longer application was made with the result of a considerable dermatitis, which kept her away for some time, but with a corresponding improvement and still more improvement after the dermatitis recovered. As soon as she could return she came back and had more treatment. A photo was taken after about six months' experience, showing loss of hair on both sides of head, but also considerable improvement. The treatment has been continued and the last pictures show the condition after over twelve months' treatment. She had not been treated for some months till the other day, when treatment was again commenced with increasing improvement. The spot on the lip is almost gone, as also are the two spots on the chest, and

the arm is almost well. This case is remarkable for the extensive area involved, the continuance of the curative effect of the X-rays after treatment was stopped, and the opportunity afforded of trying X-rays, Finsen light, and high frequency currents, all of which afforded curative action. I should give the palm to X-rays, as being more efficacious, covering a larger area at a time, and a shorter exposure, so that the general effect is more rapidly attained.

Case 3. Mr. R., an old man of 84, came with a tubercular patch of lupus. Along the right zygoma is a case of tubercles with small vesicular heads to them. X-rays were applied daily, and improvement continued from the beginning to the end, but he had to attend every other day for six months. There was little reaction in this case until the spring began, when the effect of the application became more evident, and he was at last returned as healed.

Case 4. Miss P., a woman of 38 years of age, came with an almost identical patch in position, but circular in form and with little transparent or rather pearl-like eminences to the tubercules. This was a very similar case to the last, requiring a large number of applications, but without any dermatitis. Ten minutes exposure, in consequence of irregular attendance, sometimes a month elapsing without any treatment, till at last all were healed, and there has been no return now in a year's time without any treatment.

Case 5. Miss S., a woman of 35, came with a large red patch covering the entire right cheek, had suffered from this red patch for 13 years and had been under numerous treatments to relieve the trouble which was very itchy and especially on getting heated. X-rays from a medium soft tube were applied daily for the first 14 days, then for every other day with slight dermatitis which soon passed off. This lady was very particular about her appearance and there was considerable trouble in protecting her from dermatitis and as a consequence the case has been much longer under treatment, but there is now only very slight redness remaining and the skin quite smooth, only that portion that had been scraped is still shiny and I fear will remain so.

Case 6. Miss A., 50 years of age, has a large coppery red colored patch extending over the whole right cheek, and over

the whole right ear. The skin is tense and contracted, so that the ear is smaller than its mate. This condition began as a small spot on the cheek and during the last 15 or 16 years has gradually assumed its present size. It has been treated by X-rays now for 13 months and is very much improved. The skin tension is much reduced and the color is much improved. There has never been any dermatitis at all during the whole time. The treatment has been very intermittent, due to the inability of patient to attend regularly, sometimes for several months at a time away. There is, however, very much improvement and it will, I believe, under continued treatment, be quite cured.

Case 7. Mrs. J., about 30 years of age, a very fair skinned young woman with reddish hair, applied with lupus of the left cheek, a red spot almost circular of 1½ inches across. It was of a bright red, had been troubling her for 5 years. X-rays applied for 10 minutes caused a good deal of reddening, but no actual dermatitis. She could not stand 10 minutes, therefore the dose was reduced to five to seven and one-half minutes, and continued, and at that she was, after six months' treatment, very much better. As she lived in the country could only get in once a week. She was allowed to remain away a month at a time and she is now practically recovered, and when last seen was asked to come again when convenient to see that it was quite well and required no further treatment.

Case 8. Mrs. B., a married woman of 35 years of age, with a small patch of small tubercles on lower left eyelid just below the edge of lid and extending three-fourths of an inch laterally, and one-half inch from above downwards. There were the same small tubercles with little transparent vesicles on the top. Exposure to X-ray removed them all. In this case only 14 days continuous treatment was required, but two or three treatments at the week end when she was able to come to town and now at intervals of a month. She is almost well.

Case 9. Mrs. L. This was an old woman of 74 with a patch on edge of the chin. She had an ulcerated surface under the edge of the chin, extending across the syphysis an inch, one-half on either side of median line, a very superficial ulceration and irregular edge. This was a difficult case in which to get

reaction, probably from her age, but by closely treating it daily, it gradually healed. She had to go to the country and returned after three months' absence from town, with an increase in size. This was treated and again brought to a stage of almost a cure, when she had to go away again and I suppose she will return, some time.

Case 10. Mr. D., aged 50, a florid, fresh colored man working on a farm. On both cheeks were varicose capillaries and on both cheeks were small patches disseminated over the surface, exuding a small watery discharge and with a thin yellow crust covering each spot. He also had an epitheliomatous ulceration with granulations raised above the edge opposite the three dorsal vertebra in the median line. These had been existing for about four years with very numerous remedies applied to no purpose, and after a fortnight's daily application, he went back to the country very much relieved, the face nearly well, and the ulcer reduced to a level with the surface. After an absence of a fortnight more the ulcer on the back was reduced to three-eighths of an inch in diameter, and he now reports himself quite well.

All these cases are types of various exhibitions of lupus, all tubercular, some showing distinct tubercles with little vesicles on their summits, others only very slightly raised, diseased areas appearing more as red patches than as real tubercles, others showing great thickening of the skin and dark coppery brown stains, some exuding a little watery discharge, some no discharge at all, yet all, when examined under the microscope, reported as tubercular lupus.

All were cases of long duration, one especially, having existed 32 years. All had been treated by surgeons and numberless kinds of application had been made but no permanent benefit was derived . All have been so far cured, or relieved to such an extent, that cure is almost certain in a comparatively short time.

Where dermatitis was produced, healing went on more rapidly and continued to go on for some time without any treatment. Of these cases No. 1 was treated with a 110 volt current and 5 amperes, 550 watts put into the coil which was a 7 inch spark coil.

No. 2. Eighteen inch coil, 110 volts, 6 amperes, 660 watts, mercury dipping break and condenser.

No. 3. For first 14 days a 30 inch coil, mechanical electrolytic break, 220 volts and 2 amperes, 440 watts, and part of the time with an 18 inch coil, 110 volt and 6 amperes, 660 watts, and later returned to 30 inches, 220 volts and 2½ amperes to 3, 550 to 660 watts.

No. 4. Thirty inches, 220 volts, 2 to 2½ amperes, mechanical electrolytic break, no condenser.

No. 5. Eighteen inch coil, 110 volts, 6 amperes, mechanico electrolytic break, no condenser, 660 watts.

No. 6. Thirty inch coil, 220 volts, 2 amperes to 2½, 440 to 550 watts, mechanico electrolytic break, no condenser.

No. 7. One-half treatment with 18 inch coil, 110 volts, 5 amperes; the rest with 30 inch coil, 220 volts at 2½ amperes, 550 watts, mechanico eleectrolytic break, no condenser.

No. 8. Thirty inch coil, 220 volts, 2½ amperes, 550 watts, mechanico electrolytic break, no condenser.

No. 9. One-half treatment with 18 inch coil, 110 volts, 4 amperes, 440 watts, mechanico electrolytic break, no condenser; the other half with 30 inch coil, 220 volts, 2½ amperes, 550 watts, same break.

No. 10. Thirty inch coil, 220 volts, 2½ amperes, 550 watts, mechanico electrolytic break, no condenser.

All these cases were treated at a distance of 10 inches from the surface of skin to outside of tube and for 10 minutes at a time, except one case of fair complexion before mentioned. The number of interruptions to current was about 3,000 per minute.

The mechanico electrolytic break is one in which two platinum wires dip alternately through a glass capillary tube the size of the wire, the number of dips being about 3,000 per minute. My current is derived from the street mains, gives at my house 220 volts, but being on a motor elevator circuit the current varies at times considerably, so the highest voltage and amperage has been assumed, but as a fact there was considerable variation.

I had a visit from Case No. 1 on September 23 last, and she called to show me a number of varicose capillaries around the edges of the scars which were left as a result of the scraping to which she had been subjected previously. These were not num-

erous. Apart from the scars being a little whiter than the face, they showed up very brightly and therefore I undertook to try and get rid of them for her, which I shall go on with on my return.

ON TREATMENT OF CASES OF RODENT ULCER.

In rodent ulcer are included so many forms of the disease that it is difficult even with a microscopic examination to look upon some of the cases as the same disease.

I shall give the accounts of the cases and the results:

Case 1. I. B., a gentleman between 50 and 60 years of age was referred to me for treatment by X-rays, having been operated on twice for rodent ulcer as inoperable further. When he applied he was a thin man of fair activity and all his functions healthy and regular; a small, almost circular, patch of ulceration just below the left ear between it and the angle of the jaw the size of a quarter dollar, the edges slightly inverted and but little raised, the ulcer ash colored and with a scanty discharge upon the surface. He complained of pain around the wound and up the side of the head. There was a contraction of the platysma myoides, which produced a ridge down the side of his neck. He was treated daily with a medium tube at 10 inches distance from the target, the surrounding tissue being protected by lead shields for 10 minutes at a time. After 10 days treatment a few hairs that were below the lead shield came out, the wound began to heal around the edges and began granulating in the center. The treatment was continued and at the end of two months was practically healed, and at the end of three months the skin was quite sound and healed. He returned to his duties from which he obtained leave and took a trip to England and returned again in the autumn of 1902, remained at his duty six months, and crossed the Atlantic for Europe in the spring of 1903, and went a trip up the Nile. He came back in the summer of 1903, during which time he had been perfectly well. In May, 1904, he returned to me, in the meantime he had been again operated upon to try and remove the contraction of the cicatrix and pain which he suffered therefrom. From May 5, 1904, till May 17, 1905, he had almost daily treatment at 10 inches from the surface of ulcer to the target of the tube. The ulcer gradually, but

very slowly increased in size and at last he succumbed to the exhaustion due to the ulcer. The X-rays relieved his pain and this only temporarily, but strange to say, it produced no burning and no reaction. The current used was 110 volts at 5 to 6 amperes during the whole time.

Case 2. An old man of 84 came to me October 22, 1902, with a large ulcer of the right malar region, which had brought down the eyelid and exposed the mucous surface. There were large nodules which raised the edges one inch above the surrounding skin, and left a great hollow crateriform appearance. There was little or no discharge and no pain; it had been 5 years coming; treated in the same way by X-rays and dressed with dry boracic acid and salol. The thickened edges gradually reduced and treatment was continued till March 15th, daily, with only a few intervals. He then was considerably better, the ulcer was smaller, was discharging more freely and surface more healthy and the thickening around the edges much better. He then returned to the country and did not return. He died in the following winter. The examination by microscope reported typical rodent ulcer.

Case 3. Mr. S., came to me from the country, a man of 40 years of age, a farmer, had been operated on for fistula in ano on both sides, five years ago, his weight was 350 pounds, his height six feet one inch; he had seen several surgeons who had tried various remedies and could not suggest anything more. At the time he came to me he had a large ulcer on either side of the anus as large as the palm of the hand and extending up to the right groin, which presented indolent ulcerations connected with the glands. A fragment examined determined the case to be a typical rodent ulcer. Treatment was continued daily for two months with considerable improvement in general health. At the end of two months he had to return to the country and he went home, but there was an X-ray apparatus out near there, which he continued to use for six months when he died, the X-rays only relieving his pain.

Case 4. Mr. I. G., aged 77, came to me on September 27, 1904, with an ulcer over the left temple the size of a half dollar, with raised edges and everted. An unhealthy discharge, scanty in quantity, ash colored on surface. As he lived in the country he

only came in every other day. I tried to induce him to stay in town but he would not, but continued to come every other day, where he got 10 minutes treatment at 10 inches distance from the cathode of tube until the 5th of August last, with occasional intermissions and always away on Sundays. The treatment was continued without improvement. This was examined microscopically and reported a typical rodent ulcer. During all this time there was a thickening and necrosis of the edge which became nodulated and much raised up; with sloughing going on in the substance of the nodules, he gradually became weaker so that he could not come in for treatment and he had to give it up as he would not come and live in town and is gradually fading away and I expect to hear of his death at any moment. He suffered a great deal of pain which X-rays relieved, but has gradually grown weaker and cannot get along without sedatives which upset his digestion.

These four cases, notwithstanding their long and continuous treatment, showed not even the slightest sign of even dermatitis, much less X-ray burn, but none improved. The treatment in the two latter cases was with a Gundelach tube energized by a 30 inch spark coil with a 220 volt current at 2½ amperes, for 10 minutes at a time at 10 inches distance. The other two were treated with a Gundelach tube energized by an 18 inch coil, 110 volts and 6 amperes.

Case 5. Mrs. H., aged 50, came to me September 10, 1902, with an ulcer extending from the inner canthus of left eye down and out away from the nose towards the cheek, raised up above the level of skin and becoming tubercular in the edge at the lower end three-fourth inch wide and double that in length; has had the disease 8 years and has not been able to get any relief. Exposure to X-rays from the same tube at the same distance, was continued daily for two months, the rest of the face shielded by lead sheet, then an interval of a fortnight and she returned from the country much improved. Treatment was continued at intervals till 30th of October, when she was healed up and skin perfectly smooth. She returned at the end of November and had a small round transparent vesicle on one edge of the old cicatrix with veins crossing it in all directions. This was opened and a portion removed for testing with same result, reported typical

rodent ulcer. Six treatments healed this up and by the 7th of December, 1903, she went home again. She returned at the end of March with a small flattened inflamed spot somewhat diffuse, with sense of fluctuation. This was opened, a little fluid serum escaped and a further application of X-rays, to the end of April, completely healed it again. I saw her again in July, when the old ulcer was quite healed. In September she returned again with small veins showing on the edge. She was treated on alternate days, 10 days or a fortnight as she could stay in. On December 10, when she appeared quite well, she went home and I have only seen her once since.

Case 6. Mrs. I. came to me on the 15th of November, 1893, with an ulcer of 6 years' standing on the center of left cheek. She was about 60 years of age, with fair complexion, florid cheeks with varicose capillaries, and trembling palsy. She had X-ray treatment in the same way from a 30 inch coil, mechanico electrolytic interrupter, an alternative spark gap of six inches, 2½ amperes in primary current applied daily for six weeks, no burning, slight dermatitis began to show itself, treatments were reduced to every other day and continued for another week when it was much better and without further treatment was healed, since which time I have not heard of her and believe it remains cured.

Case 7. Mr. O., a bartender. A small ulcer of five years' standing; is visible on the right side of nose. This was treated with a Gundulach tube at a distance of 10 inches from the tube and a month's treatment every day, except Sundays, produced the result shown in the photo quite healed and not seen since.

Case 8. Mrs. C., aged 82, came to me with a small ulcer on the nose, one-half an inch from the tip, which had eaten through into the right nostril, of four years' standing. Three weeks' daily treatment with the same Gundulach tube and energized by 18 inch coil, the ulcer was quite healed, being obliged to go back home. In three months time she returned with a small ulcer commencing in the old cicatrix. The same treatment healed it a second time and she returned home again, since which time I have not heard of her now, two years ago. Her brother was a surgeon who had tried everything.

Case 9. Mrs. M., a widow of 40 years of age came with a small ulcer on the tip of the nose about one inch across the nose, with the same characters; treatment in the same way with the same tube at the same distance; healed this up with treatments daily for alternate fortnights for a period of three months; healed this ulcer and she has not returned now for two years.

Case 10. Mrs. B., aged 50, came with a small ulcer on the middle of right cheek, of four years' standing, was cured by the same treatment applied alternate days for three months.

Case 11. Mrs. L., a lady of 60 years of age, was referred to me with a small ulcer of three years' standing, extending downwards for an inch below the margin of right eyelid and one-fourth inch wide. This was treated in the same way for two months daily, at which time it healed up and has so remained for 18 months.

Now I should like to ask as all these were reported as typical rodent ulcer, what is the difference in these cases that all except the first four cases should have healed up, and the other four not and why so long treatments with the same apparatus should not have produced any reaction at all, yet relieving pain? Is it simply the difference of constitution or is there some difference which the microscope does not reveal that should make the so great difference in the result in the same treatment?

DISCUSSION.

Dr. Sinclair Tousey, New York: I have had remarkable success with one case of lupus of the nose, which is still under treatment, by means of the use of a unipolar X-ray tube, which has the general shape of a vacuum electrode. It is connected with a high frequency apparatus and has a wire which terminates in a tiny concave mirror, which as the high frequency current is alternating is the cathode half of the time. The cathode rays are concentrated on a platinum disk, and it is only when the tube is in contact with the tissues that the other (ground) connection is made and the yellow fluorescence of the X-ray is perceived. This tube is applied directly to the surface to be treated. A tiny

shower of sparks is thrown from that portion of the surface of the tube which is not in direct contact with the tissues.

In the treatment of these cases with the ordinary X-ray tube I have been lately using an original method of measuring the dosage. It depends on four factors. I make note of the distance of the anti-cathode from the surface to be treated, the time of exposure, the quality of the ray and the intensity of the ray. For the latter measurement I take an ordinary fluoroscope and ascertain how far from the light I can go and still get the fluorescence. I use some heavy metallic object held in front of the fluoroscope as I go back.

When the intensity of the X-ray is such that a visible fluorescence is perceived at a distance of twelve yards or meters from the X-ray tube, the intensity is said to be twelve (Tousey).

Of course, with the same intensity and the same quality, the time and distance for the exposures would be the same in every case. If the intensity of any apparatus were greater or less than twelve (Tousey), then the time of exposure would be correspondingly modified. In my cases the exposures have been for about five minutes at ten inches from the anti-cathode with rays of No. 6 Benoist penetration, and intensity twelve (Tousey).

Providing these four factors of the distance from the patient and the quality of the ray, and the time of exposure, and the intensity of the ray are identical, it makes absolutely no difference what form of apparatus is used for these results, or how many amperes of primary current or milliamperes of secondary current are applied.

Dr. Charles Lester Leonard, Philadelphia: Persons who have been the victims of some skin disease for a long time are very resistant to X-ray treatment. I had a patient, a child, nine years of age, who had suffered from a skin disease for seven years. I used a very energetic tube but it did not burn the child. She seemed to possess an immunity to the effect of the ray. I think that might be explained by assuming that the disease was responsible for such an immunity or the remedies that had previously been employed had hardened the skin.

The Treatment of Non-Malignant and Non-Tubercular Skin Lesions

BY DR. W. S. NEWCOMET,
Of Philadelphia.

In undertaking to review this subject it would be presumptious to give a detailed description of any series of cases, as it would simply occupy valuable space and little would be gained; therefore only a short resume of each disease under consideration will be given, with attention to the more unusual aspects that have come to notice.

As year after year passes the conservative element in medicine acknowledge more and more the value of the Roentgen ray, and this has been brought about by two great factors; our results are much better, while our failures and accidents are fewer; this is chiefly due to a more careful selection of proper cases for treatment, while in many instances an exact prognosis is often given. At the same time the Roentgen ray has been recognized to be a dangerous as well as useful agent, and very few institutions at this date relegate this department to some unskilled operator, as was done in the early years. We must acknowledge that this line of work is decidedly more tedious than writing a prescription, but will any other form of treatment in medicine accomplish the same result?

ALOPECIA AREATA.

Our experience has been decidedly favorable in cases where this mode of treatment has been adopted, and the journals contain many reports that will also substantiate it. However, some authorities in dermatology still object to this method, claiming that most cases of this disease usually re-

gain the normal growth of hair in time; but it would seem that the argument of a French physician was somewhat to the point in this instance, where he asks: "Why should we wait for three years, as is usual under the older methods of treatment, while the same result is brought forth in three months?" We need fear no accidents in this disease, as treatment should be of the mildest character, and so far none have been reported.

HYPERTRICHOSIS.

While considering alopecia areata we might refer to what might seem to be apparently the opposite condition, where the human economy has been overindulgent. In this unfortunate condition our results were not always what might have been expected, and usually relief in these cases was only temporary. In several instances severe burns were produced, followed by considerable ulceration, in one instance lasting for three months; and while there was distinct evidence of an x-ray scar after healing, yet the hair returned. The idea of producing a deep burn in these cases was due to the fact that on several occasions after nevi were treated the downy hair covering the face did not return, leaving the area quite conspicuous. Lately very few cases of hypertrichosis have accepted treatment when the ultimate result was explained.

ACNE.

Favorable results may be expected from the cautious use of this agent in all forms of this disease, and no objection can be offered to its use, as only very mild x-ray from a moderately soft tube should be used, the time varied according to the judgment of the operator. The hair, eyebrows, etc., should be protected, and if sufficient care is used there is very little likelihood of any accident happening. Pusey states "The results in this disease have been little short of marvelous."

PSORIASIS.

In cases of this disease where the Roentgen ray has been employed, favorable results have been reported, and here, like acne, only the mildest form of treatment is usually required. In this affection our judgment has been often taxed to know just where and how to begin, as the eruption is often so scattered and so general. Several instances have been observed where decided improvement followed by simply allowing the patient to stand in front of an active x-ray tube with no protection save the face. Although this procedure seems to be rather hazardous, if sufficient care is used accidents are not likely to happen.

ECZEMA.

Most of the cases of eczema that come under treatment will be found to heal easily, although now and then one presents itself that proves quite refractory. In such instances if a moderately severe burn is produced and then the treatment stopped, improvement usually follows. It must be remembered that the x-ray is not a general panacea to cure all impossible conditions, and in eczema above all other ailments this fact must be fully considered; for instance, where the disease is due to some direct cause or mechanical irritation, or where it is dependent upon systemic derangement, of course that must be our first consideration, otherwise the x-ray is likely to prove harmful rather than beneficial. The evidence of this is plainly seen in leg ulcers. As is well known, if the source of irritation is relieved healing usually follows, and personally x-ray treatment of these cases does not seem justifiable. The varieties of eczema in which this form of treatment stands alone is the scaling usually seen in persons past sixty, the pre-epitheliomatous or senile eczema, and one closely allied to this, Paget's disease of the nipple. In these senile cases it is wonderful to see the improvement that will follow a few light applications. But as a class, eczema will tax our judgment more than all the other conditions that present themselves for treatment.

FORDYCE'S DISEASE.

About a year ago a young man presented himself with this rather unusual condition of the buccal mucus membrane, and as other forms of treatment had proved ineffective, the x-ray was tried; although it was pushed until considerable dermititis was produced, no result followed that could be ascribed to this method.

KELOIDS.

This disease has for a long time baffled medical science; treatment in all its varied forms has utterly failed; as to a surgical procedure, there is very little to be gained thereby, for if these scars are totally removed, in the immense majority of instances a prompt recurrence is to be expected, and while the results from x-ray treatment of this condition cannot be regarded as ideal, in most cases where it has been properly employed decided improvement if not entire absorption has followed. Some failures have been due to the fact that the treatment was too vigorous in the beginning and not carried over a long enough period. It will often take a year or eighteen months to get a fair result; and as this disease is very common in the colored race, this more vigorous form of treatment will destroy the pigment cells of the skin and a more unsightly scar will follow. It will be found on the other hand that if these cases are treated with a very weak tube the skin will in time become darker, while the excess of tissue is slowly absorbed.

NEVI.

There has been a diversity of opinion expressed upon this subject, and in cases that have come under observation, although in all instances the patient seemed to be pleased with the results, my personal opinion is there still appears to be room for considerable improvement. The scars that result after the nevi has been removed lack the pigment cells, and consequently are usually whiter, and at the same time somewhat softer than the surrounding skin; this leaves the

area more or less conspicuous, but not so much so as the pigmentation was before treatment. At the same time we must consider the variety of nevi to be treated, whether it is the simple pigmented form or one that is more vascular. Unfortunately in most of these cases it is necessary to produce a severe reaction, and as these nevi are better supplied with blood vessels than the surrounding tissues, they are proportionately hard to burn. Here again is illustrated the resistance of the vascular system. Where the vesels are large, with the formation of a tumor, several successive burns may be required to obtain the desired result, but great care must be used not to devitalize the tissue, or deep sloughs may follow, with more or less deformity of the part. No doubt as we become more experienced we will learn to produce a scar that will resemble the surrounding skin, or at least blend with it.

An accident that came to notice in one instance under observation was what might be termed a late burn. It appeared about thirteen months after the primary burns had healed. The original navus occupied the whole right cheek. This ulceration was about the size of a finger nail, just above the corner of the mouth; it lasted about two months, was very painful and had all the appearances of a primary burn.

In another case, after the ulceration caused by the ray had healed the scar was the site of an unpleasant itching that continued for months; treatment in this case did not give any relief to this disagreeable symptom. Yet with all the trials that annoyed these patients, they were well pleased.

While the results are far from being perfect, these instances just mentioned in this article illustrate the fallacy, that was current until a year or so ago, where the use of the x-ray was regarded as an agent of "dernier resort" —and why should it be? Why should a case of alopecia areata or acne go through the line of innumerable useless remedies? Why should not the x-ray be employed at the beginning in suitable cases and save the patient that useless waste of time and expense?

Unfortunately the few accidents that have occurred, and usually in the cases for diagnosis, seemed to have gained greater headway than our good results; and let it be emphasized that these accidents did not occur in the cases under treatment, and now as we are just about to gain the confidence of the general profession, another adverse point has been raised; just why, is hard to tell. For the simple reason that experiments upon lower animals show that the x-ray has caused degeneration of the testicles and ovary, notice has been published warning all operators to be careful not to produce sterility in their patients. Would any physician be apt to prescribe an overdose of strychnine? Yet this accident has occurred, and is more likely to occur than the one to which reference has just been made. Ample proof with argument has been published in other articles.

It seems peculiar that a number of people in our community always stand in the way of progress, not alone in medicine, but in all lines of useful arts; the sewing machine and locomotive are typical instances; and just so in this case, there is not the least reason why this point should be raised, as evidence so far is only of experimental value.

While in most instances of local skin lesions the x-ray has proved beneficial, in ending it would be well to call attention to one where it acted quite to the contrary; a case of syphilis was mistaken for a surface epithelioma and complete destruction of the eye followed. No doubt this is an example of many other instances where the x-ray has been employed and failure resulted. It was not the improper use of the agent that caused harm, but a mistaken diagnosis. Unfortunately the great number of practicing physicians possess very little knowledge of dermatology, and where this method of treatment is to be used it will be more satisfactory to all concerned to have the point of diagnosis settled before beginning.

Roentgen Rays in Military Surgery

BY CHARLES FRANCIS STOKES, M.D.,
Surgeon in the United States Navy

When the peculiar penetrating properties and shadow effects of x-rays were made known to the world by Wilhelm Konrad Roentgen, military surgeons were keenly alive to the fact that the solution of a puzzling problem was close at hand.

At this time they were studying the curious effects of a new missile in warfare. This new missile had a core of lead, a hard jacket of steel or cupro-nickel, an ogival head and a diminutive caliber; still, with an initial velocity of twenty-three hundred feet a second, the enormous striking energy of two thousand pounds was developed, giving this new bullet marvelous penetrating powers and appalling destructive effects. At some ranges bones and soft parts showed clean perforations, while at other ranges curious disruptive effects were noted.

We would see a run of clean perforations of bones and soft parts and be quite prepared to pronounce the new projectile humane when other effects at other ranges would be brought to our attention and an opinion to the contrary seemed justified. At close range compact bone is generally extensively shattered, soft parts torn asunder, fluid saturated organs, like the bladder and stomach, disrupted, and the brain pulpified. In some cases we would find a small, clean cut wound of entrance and a normal wound of exit, while within the skin there would be little more than a pulpified mass of muscle and bone fragments. The writer had two such cases under treatment after the Battle of San Juan Hill.

The so-called wedge-shaped types of fractures and their modifications predominate, and make their study with Roentgen rays a matter of great importance, practically a necessity.

It was thought that lodged bullets under the new conditions would become extreme rarities, but strange to say, they and other foreign bodies are found in about ten per cent. of the wounded. This unexpected development is explained by the fact that the men now deploy while fighting and seek cover behind trees, earth or other protection which the bullets oftentimes penetrate almost spent, or they ricochet, and lodge. At the proper time, localizing radiography finds a useful field in these cases.

In naval warfare wounds from shell fragments and splinters cause over ninety per cent of the casualties. Their destructive effects are often mutilating in the extreme and the guiding light of the x-ray is practically a necessity in their treatment.

A Spanish shell exploded between decks on the Texas, off the coast of Cuba, killing one man and wounding eight others. The wounded were brought on board the ambulance ship, "Solace," shortly afterward, where the search for splinters and shell fragments was prolonged, tedious and trying. After the naval battle off Santiago a wounded Spanish sailor was brought along side the "Solace" in a small boat and he walked on board and to a cot which had been assigned him. Later we removed a shell fragment from his abdomen and a strip of his jacket, which he himself had torn off and stuffed into the wound to check the ooze.

Shell fragments have a low velocity as a rule, and in consequence very commonly lodge and are difficult to locate. We not infrequently see innocent looking skin wounds concealing beneath them shell fragments, comminuted bones and disorganized joints. The writer has described in a cursory way a few of the types of wounds military surgeons are confronted with in order that you may see what an important part Roentgen rays are destined to play in military surgery, both afloat and ashore.

Major La Garde, a pioneer in the field of x-rays in military surgery, has made exhaustive studies with x-rays of the effects of modern bullets on cadavers. The writer has had the privilege of using some of his radiographic slides for lecture room demonstrations. It is plain that in gunshot wounds where tension, density, fluid saturation and other factors come into play, it cannot be said that these postmortem bullet wound lesions are quite true to life.

Before considering matters of technic and equipment in military surgery in time of war, the writer will say a word about military surgeons and their work in time of peace. It is generally supposed that naval surgeons spend most of their time on board ship treating grossly healthy young adults and indulging in habits of indolence to the full extent. It is well nigh impossible for our brothers in civil life to take medical officers of the army and navy seriously in a professional way. In this a great injustice is done us. You will be surprised to hear that, in all probability, our field is broader and more varied in almost every branch of medicine than is yours in civil life; we are not privileged, however, to see the hordes of cases that gather in the great centers.

The writer employs x-rays only in conjunction with his work in general and military surgery. One or two of his recent cases have been of sufficient interest to merit reporting

Case 1. Hodgkins disease.

Patient aet. 53 yrs., the wife of an officer, was sent to the writer for operative treatment of tumors the size of a fist in each groin, and others in the post-cervical region on the right side. There were also masses in the pelvis on the right side; the spleen was not materially enlarged. Syphilis and tuberculosis were excluded. A diagnosis of Hodgkins disease was made and was later on confirmed by Harvey Cushing of Johns Hopkins Hospital. The patient could take but little arsenic, still it was exhibited from time to time. She was x-rayed twice a week for one month, then once a week, until eighteen exposures in all had been given. The treatment was continuous, except for a break of two weeks, beginning January 7, 1905, and discontinued May 1st, the

tumors having completely disappeared. Dosage: Three minutes exposure with a seventy cm. Gundelach tube, anode distance, eight inches, low voltage and amperage, slow interruptions. This patient reports no return of symptoms under date of September, 1905.

Case 2. Kernel of peanut in right lung.

Patient aet, 6 yrs., boy. Kernel of peanut located with fluoroscope and radiograph at right fourth intercostal space about an inch outside the sternum, confirmed by the physical signs with subsequent clearing up and recovery.

Case 3. Fracture of a carpal scaphoid.

Case 4. Two epitheliomata.

Two epitheliomata of the face each three-fourths of an inch in diameter; one located on the left cheek, the other on the left side of the nose. The growth on the cheek yielded promptly to the same dosage as employed in case 1, while the lesion on the nose has stubbornly resisted treatment until quite recently. It is probable that the difference in circulation and nutrition in the two parts accounts for the difference in behavior under the treatment.

TECHNIC.

In the matter of technic in kidney work the long exposures with low voltage and amperage, and slow interruptions, as recommended by Dr. Leonard, have given the best results in my hands. The rapid work does well in the extremities and thorax.

It is not generally known that the navy has in commission hospitals of good size in most of the important cities on the Atlantic, Pacific and Gulf Coasts, and smaller hospitals in Porto Rico, Alaska, Hawaii, Samoa, Guam, the Philippines and Japan. The larger hospitals are superbly equipped with Roentgen ray apparatus, modeled after an outfit devised by the writer, about two years ago, with the co-operation of the Kny-Scheerer Company. The entire plant is mounted on a steel truck with rubber-tired wheels, is easily mobile, and can be used in lecture rooms, wards or labora-

tories, as occasion may demand. The army hospitals are amply provided with apparatus.

During hostilities there are definite situations in which Roentgen rays are employed in both the army and navy. In the field assistance is given the wounded at the firing line and at several points in the rear until the base hospital is reached.

At the firing line hemorrhage is checked. first-aid dressings are applied, and the wounded prepared for transportation to the dressing stations, which are three or four hundred yards back, under cover. Here men are nourished, stimulated, identified and tagged. Tourniquets are removed and dressings further secured. The next point at which assistance is given is in the field hospital several hundred yards further toward the base. Here operations of necessity are performed. The patients are carried still further back until they are finally lodged in a base hospital. It is at this point that permanent treatment begins, and it is here that we employ x-rays with such immense profit in diagnosis and treatment. The base hospital is more or less of a permanency, while the other stations are planned to be mobile. In the navy, under certain conditions, a hospital ship, or large man-of-war, becomes the base hospital.

Our preparations for battle at sea consist in the establishment of relief stations at many points about the ship, where assistance, such as is given the wounded on the firing line ashore, is rendered. The wounded, when conditions are favorable, are removed thence to the dressing stations. These stations correspond with the field hospitals on shore. At these points operations and dressings of necessity only are performed. The patients are then further prepared for removal to a hospital ship which corresponds with the base hospital in shore operations. On the hospital ship the wounded first have access to the benefits of Roentgen ray apparatus.

The army provides its base hospitals with portable machines which stow compactly in two pieces, one consisting of the gasoline motor-generator, the other of the coil and ac-

cessories, the whole weighing about one thousand three hundred pounds, and can be handily carried in the ordinary army wagon. The problem of weight has been the stumbling block in connection with portability.

During hostilities in South Africa storage batteries gave great satisfaction, as there was always an abundance of electricity to be had in the vicinity of the base hospitals.

The French are experimenting with a radiographic motor wagon which is novel and interesting and appears to have some value. This apparatus was first tested during the Grand Maneuvers of the East in September, 1904. It has the appearance of an ordinary automobile ambulance and is propelled by a ten horsepower motor, which gives it a speed of twenty-five kilometers an hour. During the maneuvers it traveled a distance of twenty-eight hundred kilometers over the same sort of routes that would probably have been traversed in time of war, and each day, either along the roadside, or upon the arrival at the halting place, at the end of the day's march, the wagon was immediately experimented with from a radiographic standpoint, and gave perfect satisfaction. The x-ray equipment is of the d'Arsonval-Gaiffe type. At the rear of the wagon are two doors opening horizontally, the upper forming a sort of roof for a cloth curtain to be used for dark-room purposes. When the wagon reaches its destination the motor is used to run a dynamo concealed under the seat forward. This radiographic wagon is said to have been used in connection with wireless telegraphy as well as in generating Roentgen rays. It has been suggested that a wagon of this sort be made use of in cities and towns where x-ray facilities do not exist.

In naval warfare the hospital ship of the future will be found as well equipped in every detail as the hospital on shore. The only bona fide hospital ship the navy has at present is equipped with the same type of Roentgen ray apparatus that is installed in the large naval hospitals.

In our great fleets, and where ships are operating singly, there are times when X-rays are urgently in demand in ordinary times of peace.

Each monster battleship of to-day is in reality a floating fortress and machine shop combined, manned by eight hundred odd sailor mechanics. The every day traumatisms are varied and numerous. It is hardly wise to provide each ship with an elaborate plant; still a makeshift outfit can be provided at little expense. Two years ago the writer established the fact that the wireless telegraphy coils on board ships of war can be employed for generating x-rays. Under his direction a tube, multiple spark gaps, connecting wires and a fluoroscope were taken on board the battleship "Maine" and were connected up with the wireless telegraphy coil with most gratifying results. Surgeon General Rixey is planning to equip one or more of the large ships in this way for purposes of experiment along these lines.

In bringing this brief account of the status of Roentgen rays in military surgery to a close, I would like to make an appreciative reference to the excellent work of La Garde, Borden and Gray, of the United States Army.

It would have been a presumption for the writer to have discussed the details of technic before this audience. From a former experience he well knows the profit and pleasure that go with a meeting of the American Roentgen Ray Society, and is deeply grateful for the great privilege of being with you again.

The Pathological and Physiological Effects of the Roentgen Rays Upon the Tissues and Blood

BY DR. J. RUDIS-JICINSKY,
Of Cedar Rapids, Iowa

The old saying, "Motion means life," may serve us well in all our experiments and investigations in regard to the electrochemical action and the following effects of the Roentgen rays upon the living tissues of the blood. If we expose to these peculiar rays a photographic plate, the emulsion of the same will be altered chemically by the rearrangement of the atomic structure of the molecules, or the Roentgen rays will produce a change in the absorbing material The same process will follow the exposure of living tissues, where the radiant energy, in the form of light, will make certain changes in metabolism and in the vitality, according to the produced stimulation or irritation, and will have also some effect upon the blood. If that is the case we will understand why the bombardment of particles, or the division of an electrical spark in a vacuum tube, the motion of certain rays of light, demonstrate the evidence of a chemical action of so called chemical rays, which are found more abundantly in the Rœntgen ray than any other form of light, and then these rays affect even the cells, glands, nerves and vessels in the deeper tissues with all the selective power for pathological tissue, which, in their atomic arrangements, are more complex than the cells of normal tissue. And right here we have to remember that wear and tear of the body, the action and the motion of the individual cells, differ in every individual in the performance of the varied functions, and the greater or smaller injuries to which it is frequently exposed

make indispensable for the maintenance of its integrity a more constant and widespread regeneration of the tissue. This regeneration of injured or worn-out tissues, all new growths, malignant or not, as well as the hyperplasias, are invariably brought about by proliferation or other changes in living cells and in their nutritive factor, the blood. This new formation of cells in the body persists through life with varying degrees of activity and the degrees of the effects pathological or physiological of the Roentgen rays upon them during an exposure will certainly differ with every individual tube and with all the characteristics of the person exposed. It is true that the cells of the adult organism are the offspring of one original cell, the ovum, but it is also a fact that all the new cells which appear in the body under abnormal conditions are derived from some pre-existing cells by a division of their bodies, and that the blood itself has to suffer under some other factor in addition to prolonged local irritation.

I have exposed the mesentery of three frogs simply to the air, and three frogs to the rays from a tube with a special prolongation in such a way that the best rays were falling directly upon the portion of the tissue studied under the microscope. At first there seemed to be no apparent change, soon the arteries, veins and capillaries dilated and the blood flowed more rapidly, but this condition did not last long, stasis occurred in some of the vessels and leucocytes accumulated along the inner walls of the veins, and became fixed there in large numbers, and others were dragged slowly along by the current of blood, being in puriform shapes. Same condition prevailed in capillaries. In about an hour after the exposure this emigration was increased, the cells passing between the endothelium through the cement substance, which showed all the characteristics of inflammation, due, certainly, to prolonged local irritation, changed position and exposure to the air. Extravasation of the red blood cells was slow, but the tissues around the vessels were somewhat swollen and serum poured out on the free surface with plenty of albumin and mixed with cells showing an alteration of the

blood plasma in its composition, with fibrin in abundance. These changes were first proliferative, leading to the formation of new cells, but later destruction and absorption followed with changes in the connective tissue and parenchyma cells. In the portion not rayed the whole process was much slower and not so marked, the polynuclear leukocytes going through the walls of capillaries and veins, but not the arteries. The time of these results varied considerably with the frogs which were exposed to the air only, without raying. In the frogs rayed we observed the phenomena within an hour after the exposure; in the others it took many hours, with all the peculiar variations in each individual, which, next to the hereditary causes in prolonged local irritation, may be the principal exciting factor of degeneration and absorption of the tissues, especially if we take into consideration that there may be a certain form of a chemical constituent in the blood, occuring chiefly in debilitated constitutions.

Knowing this, we easily will understand the action of the rays upon more highly organized tissue, and the effects of the process of gradual destruction, eventually removing by necrosis the diseased and poorly vitalized pathological tissues of malignant character or not. The action itself as proved by me through different experiments on guinea pigs and rabbits, and read before this honorable body at our first meeting in New York, is beyond doubt of electrochemical nature. There is nothing in the pathological conditions present in the different malignant growths, and others which may become of malignant character, to discredit an opinion that some biochemic process may be the principal factor in their etiology. The various so-called intracellular and cellular inclusions which have been isolated and so fully described by Plimmer, Scheller, Cohnheim, von Leyden and others to be parasites, and by Nosske and Greenhough as secretion deposits, are nothing more or less than transformed remains or deposits of the parent intracellular matrix, some of which has been included in the cells during the process of chemical reaction. And if so, any chemical measure that

would tend to neutralize this action or restore proper function would of itself effect a cure.

I have exposed ten guinea-pigs and ten rabbits to intense irritation daily, first for ten seconds, and later for ten minutes, with a tube at a distance of six inches or less. The guinea-pigs partly lost their hair after twenty exposures. After thirty-four exposures we had two cases of very bad necrobiosis, which was aggravated when a very low tube was used, backed by a spark gap of four inches, and a strong current.

From this time on we could study the direct anatomical changes in the exposed tissues, and found that the longer the low vacuum tube, backed by a strong current, was used, the lower became the resistance in the animals. The guinea-pigs especially seemed to suffer generally. The appetite of all the animals was good, but at the end of the experiment two guinea-pigs died. This was after the fiftieth and last exposure. The bodies of these two were dissected. Degeneration was found in the entire posterior horns and tracts of gray matter. The spinal canal seemed to be dilated, due to hemorrhages. Both animals had very extensive so-called "burns," showing special inflammatory process, with a development of fibrous tissue. The walls of the blood vessels, especially the intima, thickened, and the lumina contracted, a thin layer of necrotic tissue destroyed, also the nerves. In what order these tissues were attacked is hard to say. Strange as it may seem, injured parts—the thigh in one case was contused, and there the necrobiosis first started—are more susceptible, especially when there is something in the system which enfeebles the tissues and nerves, and prevents those injured parts resisting influences which the healthy parts can and do encounter without harm. I refer to my article, "The So-called X-Ray Burn," New York Medical Journal, March 17th, 1900. In my opinion, the vaso-motor fibres bear the brunt of the attack of excessive irritation, with a corresponding contrast of the symptoms in the tissue cells, as described above, and then we have, perhaps, a nerve affection, or the atrophic neurosis, with mortification proper.

The irritation, when sufficiently prolonged, attacks the peripheral extremities of sensory nerves, and causes a paralysis of the vaso-motors of the vascular area affected; the spasmodic contraction of the arterioles and capillaries follows, and the proper nutrition of the cells, if nothing more, is impaired. This seems to be the PRIMUM MOBILE. There might be relaxation, but all the special inflammatory steps are manifested, not only at the focus of excessive irritation, but spread perhaps over a large contiguous surface, due to communication to the vaso-motor center of the spinal cord, which is reflected over a wide vascular area.

If we examine the sections of tissues removed after prolonged raying, we easily may demonstrate the above stated facts and observe microscopically the alterations produced on the mucoses with corresponding areas whose nutrient vessels have undergone changes. These changes seem to begin first in the vascular walls, and not in the epithelium, being secondary and produced in indirect manner, because the blood in the beginning of the attack by the rays proper is not changed. The red corpuscles have to yield to the white ones, but they preserve their property of undergoing hemolysis under the influence of the serum, and the latter retains its hemolitic action. The spectroscopic property of the blood is not modified. (Baerman and Linser.)

With these changes which are directly dependent upon disturbances of the circulation, the death of tissues is caused by direct stasis in the blood vessels, giving us proof that certain Roentgen rays are similar in their actinic properties to the rays of light at the violet end of the spectrum, and that various tissues and cells react under radiation differently, their resistance being regulated, so to say, according to the quality and the chemical composition of the plasma and the amount of liquid they contain. This explains the variations of the resistance of the human body to raying, when we consider that various tissues present different resistances, and that the resistance in the same tissue varies under different circumstances in the same person, perhaps.

A few years ago some of us considered these rays in the light of a caustic, and thought that in order to obtain beneficial results, so-called "burn" must be first obtained. This theory, through the results of my investigation, as described, and by the fact that cures often occur without any decided dermatitis, and even tanning preceding, is rendered untenable, especially if we remember that the effects are not due entirely to the ray, but to a peculiar electrical discharge occuring from our tube, which will affect photographic plates, produce flouorescence on the screen and is markedly analgystic. There is electrochemical action present and that seems to exert a favorable and powerful influence upon cells of all varieties and has an effect in some malignant growths adopted for this treatment, superficial or deep, and in tuberculosis of the joints, glands, subcutaneous extravasation of blood and stimulation in leukemia, or destruction of lupus cutanious carcinoma, or sarcoma, with possible recurrence. In individual malignant cases in about three years a complete cure is obtained.

In regard to the action of the rays upon the blood we have to remember that in malignant cases, an examination of the blood may show nothing abnormal in the beginning, but later on, when the growth progresses, a secondary anaemia pernicious or chloroanaemic may appear. In twelve cases of carcinoma and sarcoma the highest erothrocyte count was 6,110,000 in a case of carcinoma of the stomach, but the lowest was 2,150,000 in a case of sarcoma of the femur. The haemoglobin in all cases reduced correspondingly, and leucocytosis was present in all the cases. The differential count made, and proved in five cases by histological examination was as follows: Polymorphonuclear neutrophiles, 95 per cent. before the surgical and X-ray treatment combined, after the exposures and operations, 65.5 per cent; lymphocytes, 3 per cent before and 27.4 per cent after; transitionals, 1.50 per cent. before and 4 per cent. after; eosinophiles, 1.80 per cent. before and 1.19 per cent. after, with some basophiles and myelocytes after the treatment, with 50 exposures as the base in all cases. These numbers seem to be

very significant, the cases being all deep. With old, superficial cases, the count is not much different. In leukaemia or better sarcomatosis of lymph and blood producing organs, it seems that the rays alone very speedily reduce the number of lymphocytes and the size of the spleen in splenic cases. Not only are the white blood corpuscles so notably reduced in number that they do not exceed, if they even equal, the normal figure, but the red corpuscles are increased in number (M. BeClerré) and all the morbid manifestations are done away with. In twelve cases of leukaemia we had about 296,000 white corpuscles proportionately to begin with, and after twenty exposures of the patients to the Roentgen ray, raying the spleen in every case, we reduced the number to about 12,000 and later on to normal, having in view the practically constant tendency to recurrence.

Usually after a few exposures of certain lesions, even where the integument was intact, we may find a more or less profuse exudate of a clear, transparent, lemon yellow fluid of a specific gravity of about 1.060 and distinctly alkaline reaction. And, as we and others found this exudate crystallizes readily upon exposure to the air, and solutions injected under the skin of mice invariably produce death within forty-eight hours. It will irritate the healthy portion of the tissues around the lesion proper and act as a caustic, and with the diminution in quantity of this exudate the healing process begins. In inoperable, deep, malignant lesions, which we have to ray just to relieve pain and suffering, if we do not consider a proper drainage with a larger growth, the danger of toxic effects will surely and soon gaze in our face, with all the secondary conditions, if an early and prompt removal of the growth itself was not possible.

A Roentgen Ray Filter, and a Universal Diaphragm and Protecting Screen

BY G. E. PFAHLER, M.D.,
Of Philadelphia, Pa.
Director of the X-Ray Laboratory of the Medico-Chirurgical Hospital

1. A Universal Diaphragm and Protecting Screen.

My first report upon this protecting screen for the patient was made in the Philadelphia Medical Journal, February 14, 1903. The improvements made in the screen and the much wider field of usefulness, I believe, however, justify a second report and demonstration before this honorable body.

At the time of the first report, the only serious danger from x-ray exposures, especially during treatment, seemed to be to the patient. Since then much more grave and dangerous effect of the ray upon the operator has been demonstrated. The need of more protection to the patient against the stray and distant rays has also been demonstrated. The original disk of lead, which is fifteen inches in diameter, when placed beneath the tube and close to it, cuts off practically all of the harmful rays which are directed downward, but gives no protection to the parts of the patient which are from three to five feet away from the tube, and gives none to the operator. Long continued exposure to the direct, and even the stray rays at a considerable distance have an undoubted serious effect upon the operator. We must, therefore, adopt every means possible for our protection. The simple addition of side shields to this disk, I believe, gives this needed protection to both the patient and the operator.

The original consisted of a lead disk fifteen inches in diameter, with a central opening of five inches, covered by

variable diaphragms. This disk is then attached to a heavy iron stand which allows any needed change in height, angle, or position of the diaphragm. To this primary device is now added either one or two shields of lead as shown in the illustration. These are attached by an ordinary spring clamp, and can be moved about the edge of the disk so as not to interfere with the wires leading to the tube, and yet so as to give protection to the patient and the operator. They are made four inches in height so as to cover the antikathode, and yet allow a part of the hemisphere of fluorescence to be visible.

An equally valuable use of this adjustable diaphragm is its application in the "diaphragm technique." The value of this technique which has been so highly lauded by our German colleagues, and which has been so ably demonstrated by our own Dr. Hulst, needs no comment from me. Last year I was slow to believe that it was of any great advantage, or, at least, I did not believe that it was worth the trouble. Since then I have been thoroughly convinced of its value. Now I seldom make a radiograph without using the diaphragm, excepting in the chest cases. The chief objection last year was the cumbersome apparatus required and the time consumed in its manipulation.

The diaphragm here described is simple, inexpensive and is easy to manipulate. As a rule, I use a two-inch opening set at a distance of fifteen inches from the plate, with the antikathode four inches from the diaphragm. This will just cover nicely the central part of an eight by ten plate. The diaphragm is easily placed in any position and can be graded to any size—the smaller the opening the sharper the detail.

This diaphragm has also the advantage of being adaptable to fluoroscopic examinations, because it can easily be turned to a vertical position, and the size of the opening can be instantly varied to suit the part under examination. The use of the diaphragm in fluoroscopic examinations gives two distinct advantages. In the first place it gives better detail. Second, it protects the patient and the operator against the

rays, excepting the radiated field under examination. The dangers from this field can be partly avoided by the use of a protecting fluoroscope, which will protect the head and eyes of the operator.

A protecting fluoroscope is made by lining the slanting sides of the box with thin sheet lead, and by placing a small piece of lead glass at the opening nearest the eyes. I had thought this was a new idea of mine, but I find it described fully by Rollins in his book, "Notes on X-Light."

If to this equipment is added the opaque gloves and apron of Dr. Price, I believe we are safe in making fluoroscopic examinations.

2. A Roentgen-Ray Filter.

Rœntgen, in his third communication (quoted by Walter, Fortschritte a. o. Gebiete d. Rœntgenstrahlen, Vol. VIII., p. 297), stated that the x-ray is composed of rays of different quality, and showed that after the rays had passed through a layer of aluminium, staniol or glass, the second layer of any of these substances studied, of like thickness, absorbed very much less of the rays than were absorbed by the first layer. In other words, there was a greater percentage of hard rays present after than before passing through these substances.

Walter has continued the investigations along this line. (Fortschritte a. d. Gebiete d. Rœntgenstrahlen, Vo. VIII., p. 297-303.) He has demonstrated that not only is the above law correct, but that all substances have respectively a selective absorbing power for the rays, in a similar manner in which the rays of the sun are absorbed by various kinds of glass which absorb certain rays, but allow others to pass through. He found that this selective power is closely related to the atomic weight. This might be expected, but contrary to our former ideas, he has found that this absorptive power does not increase directly with the atomic weight.

In his experiments he used the various metals and found that the metals whose atomic weights are found at the ex-

treme ends of the scale of atomic weights, either low or high, select and absorb the soft rays, while the metals arranged in the middle of the scale of atomic weights absorb the hard rays.

To the group of metals absorbing the soft rays belong the majority of the metals, such as aluminium, iron, copper, zinc, platinum, lead, etc. On the contrary, silver allows the soft rays to pass through and absorbs the hard rays. To this group belong also the metals which are closely related to silver in atomic weights, as palladium, cadmium, tin and antimony.

Recognizing the above two physical laws regarding the Rœntgen ray, namely, that each substance has a definite and peculiar absorbing power for the rays, and that the rays that have once passed through a substance are not likely to be absorbed by a second layer of the same substance, I decided to make a practical clinical application of these two principles. These applications can be made both in radiotherapy and in radiography.

In radiotherapy the rays which give us most concern are those that affect the skin when we are treating deep-seated disease. If the law of selective absorption be correct, then the skin has a peculiar absorbing power. Now, I reasoned that in order to filter out these harmful rays we must select a substance that resembles the skin as closely as possible. The substance resembling the skin most closely is leather. In order to make assurance doubly sure, I have selected the thickest leather possible, namely, sole-leather, which is about four times as thick as the human skin. Therefore, the rays which pass through this leather should pass through the skin without affecting it in any way, according to the other law.

Based upon this theory, during the past four months I have made use of this "Rœntgen-Ray Filter" with the most gratifying results. During the first six weeks, in order that I might be able to draw correct conclusions, I used the same amount of current with the tube at the same distance as in my work previously. As a result I obtained no redness and

no tanning at any time. Previous to the use of this "Filter" I obtained both redness and tanning from the same amount of exposure. During the past ten weeks I have increased the amount of current and lessened the distance. Still I have not obtained the usual redness nor tanning.

In one case which has been under regular treatment for Hodgekin's disease for six months, and which had been tanned dark, the tanned skin desquamated and the tanning was not renewed, although the amount of exposure was increased.

In another case which I have been treating for a year for round-celled sarcoma of the ethmoid cells, and whose face had been reddened many times, and who was so sensitive to the rays that she noticed a burning sensation each time the rays were applied previously, did not notice this burning sensation when the rays were used. Since the use of this "Filter" the amount of exposure has been increased and no redness produced.

In another case of osteo-sarcoma, involving the metacarpal bones, daily exposures have been made. By mistake, the stray rays at times struck his face, because he was in a sitting position. The face was twice as far away as the hand. A severe erythema developed upon the face, while the hand (which had been exposed to the direct rays at shorter range, and constantly, but the rays having passed through this "Filter") shows no redness.

In another case, a burn of the first degree had been produced during the treatment of mediastinal carcinoma. After two months the redness and papules, and a small ulcer had not completely healed. Further treatment was necessary. Treatment was given through the Rœntgen Ray Filter. The burn healed, and, although the amount of exposure has been increased, no further dermatitis has developed.

The above are only a few of the cases treated by this method, but they serve as illustrative examples of the value of this simple device.

This "Filter" consists simply of a disk of sole leather five inches in diameter. Or, if the hard rays are to be re-

moved, a disk of pure silver may be used. This is placed over the diaphragm opening. The size of the opening will, of course, vary with the part treated. The tube is set in position about an inch or less from the diaphragm. In order to resemble the skin more closely I soak the leather in water.

When this wet leather is placed over the hand and a radiograph made, it seems to obliterate the shadow cast by the skin. However, I consider the clinical evidence far more convincing than the radiographic evidence. I have not made clinical application of the hard-ray filter, because I do not see such a great need, nor do I see clearly my method of drawing accurate conclusions even when it has been used. It may be useful in limiting the application of the rays to the skin in cases in which deep penetration might do harm, such as the treatment of the scrotum, where damage might be done to the testicle.

It is possible, too, that we may improve some of our radiographs by filtering out some of the soft rays, or some of the hard rays, depending upon which are likely to be in excess of the needs of a good radiograph.

As a whole, this ray filter seems to be a decided step in advance. While this must be taken as a preliminary report, and not make any one bold, my results have been convincing to me and I can most earnestly recommend its use.

Dr. Henry Hulst suggested that when treating a deep-seated sarcoma why not eliminate those rays which are always giving trouble by raying through the patient's clothes, or through tin foil, aluminum, or some other substance? Select a substance according to the depth of penetration to be obtained.

Dr. George H. Stover endorsed the use of aluminum. Two years ago he was treating a large osteosarcoma of the head, involving the principal bones of the face, in which it was necessary to give many exposures. The patient was rather thin-skinned, therefore he interposed a little piece of aluminum foil between the rays and the skin and there was not the slightest sign of dermatitis.

DR. F. F. STRONG neutralizes the superficial effect of the x-ray by using a Tesla or high frequency current to excite the Crooke's tube. That ionizes the air in the vicinity to be treated; the high frequency current runs across this space and concentrates on the surface under treatment, producing an effect of bombardment and causing an intense ionizing of the skin and superficial tissues. This seems to have the effect of stimulating the trophic nerves in the skin, at the same time neutralizing the depressant action of the x-ray. Since he has used this method of exciting the tube, he has been able to treat these deep seated tumors and cause their absorption without producing in a single instance a superficial burn.

DR. KENNON DUNHAM, Cincinnati, Ohio: This brings up a point of practical importance; that is, that an ordinary pair of driving gloves worn in the x-ray room will not stop an irritation of the hands, once it is started, but it will usually protect a healthy hand. In some cases where I have been trying to get an effect beneath the skin, a piece of gauze saturated with bichloride placed on the exposed surface protected that surface perfectly, at the same time allowing the rays to penetrate, and giving the desired results. Again, this effect is proven by the fact that the operator is almost never burned when protected by his clothing.

DR. SINCLAIR TOUSEY, New York: For several years I have been using a screen for the soft rays. It consists of tin foil, arranged for application over the diaphragm of a Friedlander shield. I have found, however, that the diffusion which takes place as the x-ray passes through any such substance, interferes seriously with the definition of the object rayed; but for thicker objects, such as the head, the interposition of the screen has enabled me to bring the tube much closer to the subject and to get a stronger exposure and to secure a better picture of the opposite side of the face than I could obtain without such a screen.

MR. H. C. SNOOK, Philadelphia. It occurs to me that Dr. Pfahler's work is of unusual importance, and that he deserves a great deal of credit for having done something to-

ward enabling us better to understand some of the unknown things about the x-ray. Aside from the credit due Dr. Pfahler, I wish to call attention to the striking thing in connection with the chemistry of the phenomenon, namely, that this result of Dr. Walter's, upon which is based Dr. Pfahler's experimental work, confirms the fundamental laws underlying Wendeleeff's table of the atomic weights of the elements.

I believe that many x-ray workers have used filters from time to time and have not fully realized the importance of the actual phenomena they were investigating. It has been known for a long time that glass selectively absorbs, and that metals of various kinds do the same. As Dr. Pfahler mentioned, Roentgen was the first to discover this selective absorption, but it has not seemed to be of sufficient importance until now. Hence, Dr. Pfahler is to be congratulated on having realized the importance of the absorption of a particular kind of radiation.

Before we can attempt to determine the different kinds of therapeutic effects which come from the different kinds of radiation we obtain from the x-ray tube, we must be able to obtain homogeneous radiation from the tube. We must know the physical properties of the radiation with which we are dealing. This is an open field, and it seems perfectly feasible and practical from the work that has been done to predict that we can filter out from any x-ray tube radiation of all kinds, except the particular radiation which we propose to use. The x-ray tube which we are using may not be emitting that particular radiation, and we will not get it unless the tube is making it, although the tube may be giving out radiation of many kinds.

It seems to me that this field is the one in which investigation should be pursued vigorously during the coming year.

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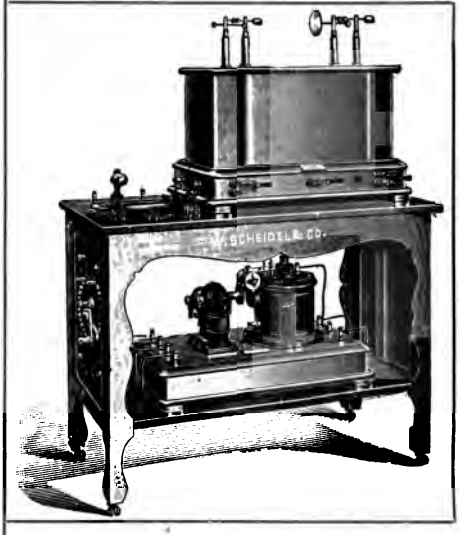

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